5-1-2010

Exploring Social Interaction at the Ancient Maya City of Copan, Honduras: A Multi-Scalar Geographic Information Systems (GIS) Analysis of Access and Visibility

Heather Richards-Rissetto

Heather M. Richards-Rissetto

Candidate

Anthropology

Department

This dissertation is approved, and it is acceptable in quality and form for publication:

Approved by the Dissertation Committee:

Co-Chairperson
James Boone

Co-Chairperson
Jane Buikstra

Co-Chairperson
Jennifer von Schwerin

David Dinwoodie

Richard Watson

EXPLORING SOCIAL INTERACTION AT THE ANCIENT MAYA CITY OF COPÁN, HONDURAS: A MULTI-SCALAR GEOGRAPHIC INFORMATION SYSTEMS (GIS) ANALYSIS OF ACCESS AND VISIBILTY

BY

HEATHER M. RICHARDS-RISSETTO

B.A., Anthropology-Geography, University of Southern Maine, 1995
M.A., Anthropology, The University of New Mexico, 2000

DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
Anthropology

The University of New Mexico
Albuquerque, New Mexico

May, 2010

ACKNOWLEDGEMENTS

I would like to thank the members of my dissertation committee, Dr. Jane Buikstra, Dr. Jennifer von Schwerin, Dr. James Boone, Dr. David Dinwoodie, Dr. Richard Watson, and Dr. Robert Santley (deceased) for their invaluable suggestions and recommendations as well as their guidance and support. Jane Buikstra has been a mentor and her constancy helped to guide my graduate career. I am grateful for the interest and encouragement of James Boone. Sincere thanks to Jennifer von Schwerin for her willingness to open her office door and without hesitation "adopt" an anonymous anthropology student. She has provided me with sound advice, encouragement, and guidance as well as research and publication opportunities. I appreciate and respect her enthusiasm and passion for research and education. I have benefited greatly from the theoretical discussions with David Dinwoodie and the methodological suggestions from Richard Watson.

I extend my gratitude to the scholars working at Copán whose research is the foundation for my work. I thank Kristin Landau for her insightful comments on the dissertation. I also would like to thank Susan Sehi-Smith for her help (and tutelage) in creating the 3D reconstructions in SketchUp.

This project would not have been possible without the support of the Honduran Institute of Anthropology and History (IHAH). I thank IHAH for the opportunity to work at Copán, for use of the library and facilities at the Regional Center for Archaeological Investigations (CRIA) and the support of the CRIA staff. Many thanks are also due to the staff of IHAH, in particular, its Assistant Director, Eva Martinez, for her enthusiasm and open-mindedness about GIS.

I want to acknowledge the financial support of the following agencies and institutions: the Latin American Iberian Institute (UNM); the Office of Graduate Studies (UNM); the Graduate and Professional Student Association (UNM); the American Society for Photogrammetry and Remote Sensing (ASPRS); the Rio Grande Chapter of the American Society for Photogrammetry and Remote Sensing; the New Mexico Geographic Information Council (NMGIC); the Center for Spatially Integrated Social Science (CSISS); and the Department of Anthropology (UNM).

Most importantly, I am deeply grateful to my husband John Rissetto and my two sons Enzo and Carlo Rissetto for their love and support. Enormous thanks go to my parents for their love and unwavering patience and support (and coffee shop hours). Finally, I want to thank my friends and cohort for their humor, intellectual discussion, and encouragement, especially Kari Schleher, Judith van der Elst, Veronica Arias, Hannah Lockard, and Greg Zaro.

EXPLORING SOCIAL INTERACTION AT THE ANCIENT MAYA CITY OF COPÁN, HONDURAS: A MULTI-SCALAR GEOGRAPHIC INFORMATION SYSTEMS (GIS) ANALYSIS OF ACCESS AND VISIBILTY

BY

HEATHER M. RICHARDS-RISSETTO

ABSTRACT OF DISSERTATION

Submitted in Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy
Anthropology

The University of New Mexico
Albuquerque, New Mexico

May, 2010

EXPLORING SOCIAL INTERACTION AT THE ANCIENT MAYA CITY OF COPÁN, HONDURAS: A MULTI-SCALAR GEOGRAPHIC INFORMATION SYSTEMS (GIS) ANALYSIS OF ACCESS AND VISIBILTY

By

Heather M. Richards-Rissetto

B.A., Anthropology-Geography, University of Southern Maine, 1995
M.A., Anthropology, University of New Mexico, 2000
Ph.D., Anthropology, University of New Mexico, 2010

ABSTRACT

This dissertation investigates late eighth and early ninth century social interaction at the archaeological site of Copán, Honduras. Two main research questions are addressed: (1) *Did people of different social classes experience different degrees of social connectivity?* and (2) *Did people living in different parts of the city experience different degrees of social connectivity?* A Geographic Information System (GIS) was used to quantify social connectivity, that is, degree of social integration or social segregation, using access and visibility as proxy measures for social interaction, and to examine whether Copán's inhabitants influenced social interaction by configuring their city to facilitate or impede communication and movement among people living at different site types and in different parts of the city.

In semiotic terms, people configure architecture and space to create "signs" that send different messages to different groups of people, and the way in which people respond to these "signs" influences how different groups of people interact in the landscape. The access and visibility of such "signs" provide information on *how* and *to* *whom* messages were sent; studies of the built environment indicate that people organize their surroundings (e.g., buildings, roads, walls) to restrict access, channel movement, and display visual messages—the *how*—in order to elicit distinct responses from different social groups—the *whom*.

While the majority of Maya studies on access and visibility focus on the internal spatial organization of a single architectural complex, usually civic, ceremonial, or elite in nature, this research investigated Copán's site configuration as a whole, integrating components of the built environment from all facets of society—civic-ceremonial buildings, royal compounds, elite and commoner residences, roads, and reservoirs—as well as natural features such as rivers, *quebradas*, hills, and mountains. Moreover, a multi-scalar approach was used to account for different levels of social interaction, ranging from sub-communities to urban and rural areas to the city as a whole.

The results indicate that Copán's layout served as a guide to daily interactions, potentially channeling people of particular social classes to specific locations and sending visual messages of wealth, power, and surveillance from and to certain groups of people and particular locations in the city. The research suggests that varying degrees of sociopolitical control existed in the Copán Valley and that there may have been intermediate-level interaction spheres controlled or managed by local leaders who played an integral part in Copán's sociopolitical landscape. The study also indicates that certain types of commoner and elite sites had more similar degrees of social connectivity than expected, suggesting that some sites in the Harvard Site Typology, based on economic status, are misclassified or represent temporal, functional, ethnic, or other differences.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Chapter 1:

Introduction

> Many city plans have been created deliberately to serve as maps of the proper structure of the cosmos as conceived in the cultures of which the individual cities are part [Ashmore 1992:173].

Most archaeologists agree that the way in which ancient peoples arranged their physical surroundings—their built environment—provides a window to the past (e.g., Ashmore 1991, 1992; Ashmore and Sabloff 2002, 2003; Blanton 1989; DeMarrais et al. 1996; Lawrence and Low 1990; Moore 1996a, 1996b, 2005; Preziosi 1979a, 1979b; Reese-Taylor 2001; A. Smith 2003; Smith 2007). This is especially true for the ancient Maya, who scholars believe planned the location of site centers, houses, monuments, and even roads to reflect their view of the heavens, earth, and underworld. Most studies dealing with the built environment of the ancient Maya examine how they laid out their architectural complexes to mirror the cosmos (Ashmore 1991; Ashmore and Sabloff 2002, 2003; Coggins 1980; Guillermin 1968; Houk 1996; Maca 2002).

This dissertation research, in contrast, regards site layout not simply as a reflection of ancient life, but also as a mechanism that shaped ancient life (Giddens 1984; King 1980; Moore 2005). Specifically, the research investigates whether the Maya living in the ancient city of Copán, Honduras, configured their city in order to facilitate or impede communication between people living at different site types. To attempt to answer this question, I have used a multi-scalar approach to measure access and visibility among five different site types to determine if a spatial hierarchy existed that helped to shape and maintain the social hierarchy. The results indicate that Copán’s layout is not simply a mirror of cosmology, but also serves as a guide to daily interactions within than cosmology.

Researchers have identified connections between the Maya belief in a multi-layered universe and in the propensity to arrange their architecture according to a quadripartite division of the world corresponding to cardinal directions (Ashmore 1991; Coggins 1980; Guillermin 1968; Houk 1996; Maca 2002; Tate 1992). In Maya cosmology, east was associated with the rising sun and birth and west was associated with the setting sun and death, while north was associated with the heavens and south with the underworld (Coggins 1980). Studies indicate that this template was replicated at several scales across Maya society, from the smallest household to the city centers (Ashmore and Sabloff 2002, 2003; Gonlin 2007; Maca 2002). While these findings are intriguing and highlight the importance of cosmology in ancient Maya site organization (and served as the springboard for this research), I believe that recent theoretical and technological advances now place archaeologists in a position to expand these ideational studies to include more sociopolitical factors.

However, the worldview reflected in site layout was not limited to representations of the heavens, earth, and the underworld—it also encompassed beliefs linking cosmic order to social order. At Classic period sites in the southern Maya lowlands, a social hierarchy existed that placed rulers at the top, with members of the royal court just below, followed by lesser nobles, and at the bottom, the commoners. As in many other ancient societies, cosmology, that is, the order of the cosmos in which supernatural beings and lords were separated from lesser or lower beings (Houston et al. 2006), provided the template and legitimization for this social structure. However, it was the daily routinization of these social categories that reinforced the cosmic order. This routinization was achieved, in part, through mechanisms such as access and visibility, which facilitated either social integration or social segregation depending on how societies employed them.

Building on these ideas, this research differs from these earlier studies in two important ways. First, it is more holistic. Most studies of the built environment focus on the internal spatial organization of a single architectural complex—one that is usually civic, ceremonial, or elite in nature (e.g., Ashmore 1991; Sanchez 1997; Stuardo 2003). In contrast, this research examines a Maya city's configuration as a whole, taking into account the spatial organization of architecture from all facets of society, including civic-ceremonial buildings, royal compounds, and elite and commoner residences, as well as roads and waterworks. Moreover, it incorporates natural features such as rivers, *quebradas* (stream cuts), hills, and mountains into the study. Second, it introduces an innovative methodology using Geographic Information Systems (GIS) that allows archaeologists to make quantifiable observations of site configuration, which is especially important given recent criticisms of the lack of empirical methods in studies of ancient Maya site planning (M. Smith 2003).

Case Study: Copán, Honduras

This research focuses on site organization in the late eighth and early ninth centuries (AD 763−820) at the ancient Maya site of Copán, Honduras. This site and time period (otherwise referred to as the "end of the Late Classic") serve as an ideal case study for four reasons. The long history of research at Copán provides voluminous survey and excavation data, an especially important circumstance for two reasons. First, the data provide evidence that most surface remains belong to the end of the Late Classic, which means that what is seen on the surface today provides a snapshot of the city's final configuration (W. Fash 1983a; Leventhal 1979; Willey et al. 1978). Second, archaeologists have carried out a full-coverage survey (100%) of the Copán Valley and instrument-mapped all visible archaeological features in the valley (24 square-kilometers), allowing for a comprehensive analysis of the city as a whole.

Third, in the late 1970s archaeologists created the Harvard Site Typology, a five-part classification that uses four criteria—size, complexity, mound height, and construction materials—to categorize Copán's sites (Willey and Leventhal 1979; Willey et al. 1978). Although these site types were originally meant to reflect economic status, researchers typically equate wealth to social status, with smaller, less elaborate sites assigned to commoners (types 1 and 2), larger, more complex sites designated as elite (types 3 and 4), and the main civic-ceremonial groups assigned to royalty (type 5) (e.g., Collins 2002; W. Fash 1983a; Freter 1994; Webster et al. 2000). The typology provides categories for analyzing how people living at different site types, and presumably of different social classes, organized themselves within the city.

Fourth, Copán's sociopolitical circumstances are ideal for understanding how people of different social classes interacted and responded during stressful times. From AD 763 to 820, a time period that corresponds to the reign of Copán's last dynastic ruler just before the "Maya collapse," the city's inhabitants experienced environmental degradation, warfare and competition, political disruption, and ideological disintegration (e.g., Abrams and Rue 1988; B. Fash 2005; W. Fash 2001; W. Fash et al. 2004a; Rue

1987; Storey 1992, 1997; Webster 2002, 2005; Webster et al. 2000; Whittington and Reed 1997). Several scholars contend that the weakened authority forced Ruler 16, or *Yax Pasaj*, to share power with a council of powerful lineage heads, and as part of this distribution of power nonroyal elite were permitted, for the first time, to erect elaborate structures with architectural sculpture and epigraphy that were on par with some of the ruler's own buildings (Cheek 2003; B. Fash 2005; B. Fash et al. 1992; W. Fash 2001; Stomper 2001).

Yet there is evidence to the contrary, suggesting that *Yax Pasaj* actually carried out a major urban renewal project in which he, not the nonroyal elite, was responsible for the elaborate construction, architectural sculpture, and epigraphy in the suburbs (Maca 2002; Plank 2003, 2004). *Why would Yax Pasaj use critical resources (both materials and labor) in such a tumultuous sociopolitical climate?* Some scholars believe that he commissioned these construction projects as part of a strategy to display his power and reach out to lesser elite in an attempt to preserve the existing social hierarchy (Maca 2002; Plank 2003, 2004; Richards-Rissetto 2007). Given the circumstances of rapid demographic, environmental, and sociopolitical change, the late eighth and early ninth centuries at Copán provide an ideal situation in which to investigate how the ancient Maya may have organized their physical surroundings (in relation to the existing landscape) to structure social interaction and influence communication between different social groups as part of maintaining social stability.

The theory of semiotics holds that cultural phenomena can be understood as systems of signs (or social configurations) that convey culturally constructed meaning (Bouissac 1998; Burks 1949). The five sites types at Copán identified in the Harvard

Typology are viewed as signs that conveyed meaning about social status. These signs, however, did not necessarily send messages to society as a whole, but were arranged within the landscape by specific groups of people, or senders, to convey messages to other specific groups of people, or receivers (Goffman 1983; Jakobson 1980; Parmentier 1987, 1997; Peirce 1966; Silverstein 1976). Using a GIS, I measured the differences in the access and visibility of these sites (or signs) to identify *who* was most likely interacting with *whom* and *who* was sending messages and to *whom* to address two main research questions.

The first question—*Did people of different social classes experience different degrees of social connectivity?*—provides information about the degree to which people of different social classes were integrated or segregated from the society as a whole. The second question—*Did people living in different parts of the city experience different degrees of social connectivity?*—examines whether patterns of social connectivity were replicated across different scales of society and helps to address the ongoing debate about the nature and degree of social replication in ancient Maya societies (e.g., W. Fash 1983a, 1983b; Freter 2004; Maca 2009; Manahan 2003, 2004; Manahan and Canuto 2009; McAnany 1995; Sanders 1989; Webster 2002, 2005). This study concludes that the answer to the first question is dependent upon the answer to the second question.

The multi-scalar approach revealed that while, in general, Copán's layout replicated and reinforced society's hierarchical class structure—with higher access and visibility correlated to higher social status—this pattern was not replicated at all societal levels. In the urban core and eastern part of the valley, elite complexes were more accessible and visually prominent than commoner households, ultimately affording them greater sociopolitical control than the elite living in the western part of the valley. The results indicate that in areas with longer occupation histories and higher settlement densities, the city's layout replicated and reinforced society's hierarchical class structure. The ruler and lesser elite lived at accessible and elevated sites that afforded them greater sociopolitical control and sent messages letting lower status individuals know that they were "watching over" them. In doing so they sent messages of authority and power and, I would argue, reminded people of their proper place in the cosmos, effectively linking social order to cosmic order.

Moreover, the quantitative measures of social connectivity revealed unexpected spatial relations that raised new questions about Copán's social organization and its traditional classification of sites (the Harvard Site Typology). The results indicate that while some site types seem appropriately categorized (at least with respect to access and visibility), other site types are not. These new questions, in turn, result in testable hypotheses that offer new directions for future research at Copán, other Maya sites, and beyond.

The *Kahkab:* Bringing Together the Built Environment and Natural Landscape

Among the contemporary Maya the term for large community is *kahkab*. *Kah* means "populated place" and *kab* means "land" or "earth"; in joining these words the Maya essentially combine the built and natural environments (Marcus 2000:236). In other words, unlike the Western concept of city as human-made, the Maya view their communities as a construct of both the natural and built worlds. The ancient Maya seem to have had similar ideas. Along the Usumacinta River in Guatemala, they constructed temples atop caves that during the wet season were filled with fast-flowing water that echoed a roaring sound up through the temples (Brady and Ashmore 1999). By fusing their built and natural surroundings, they were able to create an impressive auditory effect that produced a ritually charged atmosphere at specific times of the year. At Copán, the ancient Maya apparently used the natural backdrop of the hillsides to "heighten' certain ceremonial and/or elite structures, making them appear larger than they actually were (Leventhal 1979). These are just two examples of how the ancient Maya integrated their built and natural surroundings in order to express ideas and structure events.

Despite the importance of the natural environment, most studies seeking to equate site layout to sociopolitical factors have focused solely on the built environment because they see it, rather than the natural environment, as "encoded" with readable cultural information (Saussure 1966), and in a way this is true. For archaeologists and others, the built environment is an archive of tangible objects that provide information on the intangible ancient social world. However, architecture can be a vehicle for and an agent of cultural construction and the transmission of ideas (Moore 2005; Whincup 2004). Looking at it from this perspective, archaeologists can begin to think of the built environment not simply as a reflection of ancient Maya society, but consider it as a means of actually shaping social structure. This viewpoint necessitates taking into account the fact that for the ancient Maya the built environment worked in concert with the natural environment to create complexly ordered communities, or *kahkabs,* which helped to shape social practices.

This means that Maya architecture did not haphazardly "pop up" simply to serve as a backdrop to everyday life at Copán and other Maya sites, instead people constructed built forms (such as temples, palaces, stelae, altars, residences, reservoirs, *sacbeob* (causeways), and even agricultural features) and bounded spaces at specific locations in the landscape that helped to transmit information to particular groups of people. Although both elite and commoners were participants in site organization, many studies of the built environment are one-sided, focusing on either elite culture or commoner culture. However, this divide can be bridged using an appropriate theoretical perspective.

Using Semiotics to Bridge Top-Down and Bottom-Up Approaches

In archaeology, studies that focus on the elite are referred to as "top-down," while those centered on commoners are considered "bottom-up." Top-down approaches tend to investigate monumental architecture, richly endowed burials, and other vestiges of elite culture to understand social organization, ideology, and political practice (e.g., Baudez 1989, 1994; Kowalski and Fash 1991; Morley 1920; Newsome 2001; Sanchez 1997). In contrast, bottom-up approaches typically use household remains to reconstruct the daily activities of commoners (e.g., Douglass 2000; Freter 1988, 1992, 1994; Gonlin 2007; Lohse 2007; Webster and Gonlin 1988). Although both approaches provide a wealth of knowledge, they unfortunately tell us very little about interaction between these two groups.

This research uses a theory of semiotics to overcome this problem. Since its inception by Charles Peirce in the 1930s, one branch of semiotics has helped scholars to better understand how people communicate with one another (Gardin 1992; Gardin and Peebles 1992; Goffman 1983; Jakobson 1980; Parmentier 1986; Preucel and Bauer 2001; Silverstein 1976). Its basic tenet is that a triadic relationship exists among objects, signs, and interpretant (Peirce 1966). In this relationship objects become signs when, and only when, individuals assign meaning to them. This means that for archaeologists to reconstruct the meanings of ancient signs, they must take into account *who* is creating these signs and *whom* these signs are targeting. Senders, or addressers, send messages via signs to receivers, or addressees (Goffman 1983; Jakobson 1980; Silverstein 1976). Archaeological remains provide evidence to help identify the identity of both senders and receivers; however, identifying senders is often more straightforward than identifying receivers. For example, the five site types at Copán can be considered signs, and depending on site type the messages they convey can be seen to have been sent by either commoners, lesser elite, or royal elite. However, to understand to whom these messages were being sent, that is, to identify receivers, archaeologists need to understand *how* these messages were being sent.

In order to reconstruct *how* and *to whom* the ancient Copanecos sent messages via the built environment, this dissertation research uses measures of access and visibility. Human behavioral studies indicate that the accessibility and visibility of buildings, roads, and other features influence how people move about landscapes, and that people make use of this fact by organizing their surroundings to restrict access, channel movement, and display visual messages to elicit distinct responses from different social groups (Crown and Kohler 1994; Hammond and Tourtellot 1999; Hillier 1999; Hillier and Hanson 1984; Llobera 1996, 2001, 2003, 2006; Tourtellot et al. 2003; Tourtellot et al. 1999; Stuardo 2003). Ultimately, the way in which different groups of people respond to these "signs" influences how they interact in the landscape, and because access and visibility are measurable phenomena, archaeologists can use them to simultaneously study elite and commoner culture (Richards 2003; Richards-Rissetto 2007, 2008).

Access and Visibility among the Ancient Maya

Archaeological evidence suggests that access and visibility served as mechanisms of social integration and/or social segregation in ancient Maya society. David Webster (1998:40) writes that Maya builders obviously intended "to channel movement and create visual impressions of sanctity and power" through the organization of architecture. For example, at Copán the east and west *sacbeob* channeled people into the large, open Great Plaza, presumably for ritual events that brought together people from all walks of life (Baudez 1994; Sanchez 1997). It is likely that the accessibility of these plazas sent a message of unity—"we are one"—and created a sense of community and shared identity that helped to maintain social cohesion between commoners and elite.

In contrast, the highly restricted spaces of the royal courts most likely sent different messages to different people. At most Maya sites, intimate access to the royal court was "restricted to the nobility and invited guests, spatial control being an integral part of the orchestration and wielding of regal power" (Reents-Budet 2001:225). On the one hand, it forged social bonds between the royal elite and other elite. On the other hand, it segregated the elite from the commoners by not permitting commoners access to certain spaces. This segregation helped to establish and maintain social inequalities. By making these royal spaces more exclusive and separating the elite from the commoners, the ancient Maya were effectively replicating the order of the cosmos in which supernatural beings and lords were separated from lesser or lower beings (Houston et al.

2006). Archaeologists have talked about the accessibility or inaccessibility of spaces within courtyard groups, but no one has actually empirically evaluated whether this phenomenon is replicated for cities as a whole. The research described in this dissertation addresses this gap.

The notion of linking lesser to lower was present not only on the horizontal plane, but also on the vertical. The ancient Maya apparently employed raised platforms to elevate entire compounds and link the earthly realm to the "vertical succession of both the Maya underworld and heavens" (Messenger 1987:394). This mechanism of "architectural vertical zonation" not only used building terraces to constitute the many tiers of the universe on earth, but used imagery as well. For example, the imagery on Temple 22 at Copán worked in tandem with its three-story design to reflect the Maya universe—a vertical tripartite division comprising the underworld, the earth, and the heavens The lowest level's flower mountain and cave imagery represents the underworld, the middle level with its portrayal of the ruler reflects the earth, and the upper story's sky, celestial bodies, and patron deity motifs are representative of the heavens (Ahlfeldt 2004; von Schwerin, 2009 in review). This use of vertical and stepped imagery extends to the human body, and pictorial scenes linking royal costumes to the levels of the universe are believed to represent "relations between the parts of the king's body and the divisions or aspects of the universe" (Baudez 2000:136).

Such vertical and stepped imagery was also used to depict deities floating over lords and lords looking "down" over lower-ranking persons, in essence placing those of higher status above those of lower status (Houston et al. 2006). In effect, such vertical zoning provides a model linking cosmic space to social space. This social rather than purely symbolic model is replicated in architecture. For example, at Copán a large amount of labor and resources were invested in elevating the Acropolis, or the ruler's domain, so that it towered above its immediate surroundings. Its height probably conveyed a variety of messages, but one of the most important was that the ruler's high position placed him closer to the heavens, making him the only person allowed to interact with supernatural ancestors (Ahlfeldt 2004; Baudez 1994; Houston 1998; Messenger 1987). This idea of height appears to have been directly linked to visibility as well as importance and longevity, at least in Copán's main civic-ceremonial complex, where multiple construction phases coincided with sacred places and taller buildings (Agurcia Fasquelle 2004; Agurica Fasquelle and B. Fash 2005; W. Fash 2001; Sharer 2004; Sharer et al. 2005).

The ancient Maya appear to have thought that "the individual who 'sees' is always someone of high status, an overlord or crucial visitor" (Houston et al. 2006:173). Sight is believed to have had an authorizing or witnessing function, and someone who was "all-seeing" was therefore also "all-knowing" (Dreyfus and Rabinow 1983; Leone 1984). Scholars assume that such authority was a privilege of the king, the royal court, or other elite. However, in order to be "all-seeing" these individuals had to give the impression that they were higher than those around them. In other words, they had to be more visible (Leone 1984). The assumption is that higher visibility conveys higher status because it places these individuals higher in the cosmos. However, as with accessibility, this assumption about visibility being replicated through society as a whole has not been empirically tested. This research gap is due in large part to the fact that current methodologies are designed to evaluate individual structures or isolated architectural compounds, not the configuration of sites as a whole.

Access Analysis

Studying the spatial organization of architecture to better understand ancient people is not new. In fact, it has played a profound role in our understanding of ancient Maya sites (e.g., Andrews 1975; Ashmore 1991; Ashmore and Sabloff 2002; Coggins 1980; B. Fash et al. 1992; Heydon 1981; Houk 1996; Koontz et al. 2001; Kubler 1962); however, such studies have typically focused on monumental or elite architectural compounds (e.g., Andrews and Bill 2005; W. Fash 1989; Hendon 1987; 1991; Sanders 1989; Webster et al. 1998). Moreover, they tend to study this architecture without a larger spatial context. In other words, they look for meaning without taking into account *how* the placement of the structures within the site's larger configuration actually works to convey meaning.

Recently, however, a few archaeologists have suggested that in studying ancient buildings, scholars should investigate *how* meaning is conveyed in order to get at the meaning itself (Ashmore and Sabloff 2002; Blanton 1989; Smith 2007). Two examples of such research in the Maya region involve projects at Copán and at La Milpa in Belize. Allan Maca's (2002) research at Copán looked at how specific architectural groups were positioned with respect to the site's civic-ceremonial center to postulate cosmologically derived urban boundaries, while recent work at La Milpa determined that the visibility of outlying stelae from the site's civic-ceremonial center served as a mechanism of cultural integration (Hammond and Tourtellot 1999; Tourtellot et al. 2003; Tourtellot et al. 1999).

These two studies illustrate that the ancient Maya placed or positioned architecture within the landscape as a whole (the *kahkab*), to influence both *how* messages are sent and *what* the messages were. Nonetheless, they still focused on isolated groupings of elite materials rather than on architecture from all facets of society. There is absolutely nothing wrong with such an approach; however, in order to test whether or not the ancient Maya organized their cities to structure social interaction and reinforce the existing social order, archaeologists need to study site configuration as a whole. A site's configuration, or its morphological form, is a cultural product, and the way in which it is laid out influences how cultural information is transmitted (e.g., Hillier 1999; Hillier and Hanson 1984; Hillier et al. 1993; Marcus 1983; Presiozi 1979a, 1979b). Through mechanisms of access and visibility, people send messages that help integrate some people into the social group while segregating others. Access structures social interaction by influencing pedestrian movement *to* and *through* space, while visibility structures social interaction by visually connecting certain groups and excluding others (e.g., Bustard 1996; Ferguson 1996; Hillier 1999; Hillier and Hanson 1984; Hillier et al. 1993; Ratti 2004, 2005; Shapiro 2005). Although both access and visibility influence what messages are sent and how, different methods are required to measure the roles that each of these mechanisms may have played in structuring ancient social interaction.

Most archaeological studies of access use a form of configurational analysis called space syntax, which analyzes the structure of space to predict pedestrian movement (Bustard 1996; Ferguson 1996; Hillier 1999; Hillier and Hanson 1984; Shapiro 2005; Stuardo 2003). This approach is based on studies indicating that spatial configurations are the primary generators of patterns of movement (Hillier 1996; Hillier et al. 1993). In other words, people are more likely to walk *to* or *through* certain spaces rather than others because of the way in which buildings and spaces are laid out. Spaces that people are more likely to walk to or through are considered to be more connected with the system as a whole, while spaces that people are less likely to walk to or through are less connected. This degree of connectivity is measured as an integration value. Locations with low integration values are more accessible than those with higher integration values (Hillier 1999; Hillier and Hanson 1984; Hillier et al. 1993). These degrees of access are related to variables such as political control and ritual exclusion, and therefore such "patterns of access—to cities, central administrative ritual/precincts, or individual buildings—can provide information on ancient social inequality and class structure" (Smith 2007:36). Although space syntax has proven useful and provided insight into ancient social interaction within architectural compounds (e.g., Bustard 1996; Ferguson 1996; Shapiro 2005; Stuardo 2003), I believe that because of the way in which it measures integration, its utility for studying access in large Maya centers is limited (Cutting 2003).

Limitations of Space Syntax Methods

To measure integration traditional space syntax methods use axial graphs, which rely on simple longest-line-of-sight mapping derived from planimetric representations. This is a problem, because measurements are made with axial maps, which are flat, two-dimensional datasets (Ratti 2005). This method may be sufficient for measuring the accessibility of interior spaces for buildings or even architectural compounds. It cannot accurately measure access across large Maya cities, however, because it does not take into account distance, topography, or the effects of barriers to and facilitators of movement in the landscape. Taking these factors into account is important because Maya cities consist of both the built and the natural environments (the *kahkab*). Movement from one location to another does not occur on a flat surface, but rather up and down hills, across rivers, and along roads. Such features helped to facilitate movement or impede it, which means that to accurately measure integration differences, the *cost* of movement (including distance) must be considered. Unfortunately, axial maps cannot be used to measure the cost of movement across expansive landscapes and axial graphs consider only discrete objects such as doors, rooms, and walls, not the surfaces between these objects (Batty 2004; Ratti 2004); however, these problems can be surmounted by making use of the capabilities of GIS to devise an innovative methodology.

An Alternative Approach to Measuring Integration

Zipf's *Principle of Least Effort* states that interactions between places are inversely proportional to the cost of travel between them (Zipf 1949). This means that people are more likely to travel to places that they can reach more easily or with a lower expenditure of energy. It follows that people are more likely to interact with people living at locations that are more easily reached than those living at hard-to-reach places, but proximity is only one variable affecting travel cost. Other factors, such as topography, hydrology, and cultural features, also affect travel cost or the likelihood that interaction will occur, and axial maps and axial graphs do not take these factors into account.

A GIS is a computerized tool that not only stores and manages separate data layers (e.g., hydrology, buildings, roads, and topography), but also creates and analyzes data. It is this ability to create new data (by converting vector to raster data) and to analyze both old and new data that makes GIS an ideal alternative to axial graphs for measuring integration at ancient Maya sites. In GIS terms, axial graphs make measurements using a vector map; however, using GIS a much more powerful data type can be produced—the raster map.

The raster map is a rectangular matrix of cells, or pixels. This matrix forms a continuous surface that stores values such as elevations, building heights, and impedance costs. Distance can also be measured across the raster map. Moreover, algorithmic functions can be performed on raster maps, meaning that different layers (with different values) can be added, subtracted, or multiplied. These functions are useful because they allow archaeologists to merge natural features such as hills and rivers with cultural features such as buildings and roads into a single raster map, termed an urban digital elevation model (DEM). This urban DEM—consisting of 3D information using a 2D matrix of elevation values—can then be used to calculate the cost of movement across an ancient landscape.

From such a surface, measurements of the average cost of travel from a certain point to all other relevant points can be made (Ratti 2005). In this way, differences in cost to travel from one type of household to another or to other points of interest (such as stelae or monumental architecture) can be measured. These measures, referred to as integration values (as in space syntax), are used to identify interaction patterns among different social groups, allowing archaeologists to test the question of the whether the occurrence of spatial segregation between social groups in prehistoric cities can be *quantitatively* addressed. These values allow us to assess the potential for interaction among different groups by providing information on the spatial interconnectedness of people based on where they live.

Spatial studies show that site configuration affects social connectivity. Residents of compounds located in peripheral areas away from high-density settlement are typically less connected, that is, less accessible, to a society as a whole than are people living in densely occupied urban cores. However, less obvious is the degree to which people living at specific compounds were connected to different subsets of society. For example, at Copán, *Was the Great Plaza more accessible than the Acropolis or the Royal Courtyard? Did people living at type 3 or type 4 sites have greater access to the spaces of Ruler 16's private courtyard than those living at type 1 or type 2 sites?* Similar questions can be asked about the role accessibility played in social connectivity for people living at other site types at Copán. Studies of access at ancient Maya sites typically focus on the interior spaces of elite residences and civic-ceremonial complexes. They assume access is limited to other elites (unless the person is a member of the household or serves as some sort of laborer), and this is most likely a valid assumption. However, such studies do not address the degrees of social connectivity between different social groups (royalty, nonroyal elite, and commoners) and people living in particular locations.

I propose that such questions can be quantitatively addressed using Zipf's *Principle of Least Effort* to develop a new measure of integration. This measure of integration provides quantitative data on how people living at different site types may have interacted, because it is based on two assumptions: (1) pedestrian movement is *most* determined by a city's configuration, or spatial organization, and (2) people are more likely to interact with people living at locations to which they can more easily travel, that is, to locations with lower travel costs. In sum, the integration values calculated through GIS can provide data by which we can understand whether or not Copán's inhabitants configured their physical surroundings to channel pedestrian movement in order to reinforce the existing social hierarchy.

Measuring Visibility

Studies of human perception indicate that visibility parameters fundamentally affect interactions between humans and their environment (Ratti 2005). Vision is seen as the most important sense in landscape navigation (Llobera 2001, 2006). *Attraction* theory states that built forms with more powerful visual fields (larger fields-of-view) are more likely to attract people (Llobera 2003). Because visibility affects how connected people are to particular places within that landscape, it influences both the places to which people travel and how they move through the landscape to those places. Unfortunately, almost all studies of visibility at Maya sites are either subjective or use a simple line-of-sight analysis. Line-of-sight analyses typically look at sight lines between monuments (buildings and stelae), and such work has proven useful for reconstructing astronomical alignments or hinting at connections between objects; however, these studies tell us very little about other ways in which the ancient Maya may have made use of visibility.

For example, studies show that more visible connectivity between places equates to greater integration between those places (Hillier 1999). In fact, recent studies at La Milpa support the idea that visibility served as a mechanism of cultural integration for the ancient Maya (Hammond and Tourtellot 1999; Tourtellot et al. 2003; Tourtellot et al. 1999). Despite these findings, archaeologists have not pursued this line of research in the

Maya region, for two probable reasons. First, there has not been an integrated methodology that allows archaeologists to empirically measure such phenomena. Second, because most buildings had perishable superstructures, their heights are unknown. However, using GIS and the urban DEM, the method used in this dissertation overcomes these limitations by using criteria from the Harvard Site Typology to estimate unknown building heights and to reconstruct visual connectedness between Copán's different social groups.

Mayanists typically assume that civic-ceremonial architecture and elite residences had more powerful visual fields, that is, they could be seen by more people, than commoner households (Houston et al. 2006). They believe this to be true for two reasons. First, most Maya elite architecture is taller than non-elite architecture and therefore is more likely to be seen. Second, both ethnographic and archaeological research suggests that the Maya view those in power as watching over or looking down upon the hoi polloi (Hammond and Tourtellot 1999; Houston et al. 2006; Tourtellot et al. 2003; Tourtellot et al. 1999). While it is true that both of these factors affect visibility, it must be remembered that it is not only a building's height, but also its location within the broader landscape that affects its visibility.

In many urban centers, large buildings have low fields of visibility because they are surrounded or shadowed by other large buildings. This means that they may have less powerful visual fields than much smaller and more ordinary buildings found in other areas of the city. Fortunately, a building's visibility can be *quantitatively* measured, rather than simply assumed, using standard GIS tools. In other words, archaeologists can now use empirical methods to test the assumption that civic-ceremonial and elite architecture was more visible than the households of non-elite people.

Directionality

The concept of directionality is an important part of Maya cosmology. The cardinal directions (north, south, east, and west) and their center form a quincunx, or five-part plan (Figure 1.1). Among the contemporary Maya the east-west axis takes primacy over the north-south axis. This belief dates back to at least the sixteenth century as maps of that age from the Yucatán region of Mexico placed east at the top (Rice 2004). East, the direction from which the sun rises, represents the sun and the top of the heavens and west, the direction in which the sun sets, represents the moon and the underworld (Hanks 1990). Interestingly, the modern Chorti Maya (and several other Maya groups) do not have words for north or south (Hanks 1990; Wisdom 1940).

Among the ancient Maya east and west held similar meanings, but the meanings for north and south appear to have been different. Buildings and architectural complexes were oriented in cardinal or off-cardinal directions to reflect specific beliefs or ideas. For example, in the Cuyumapa Valley of Honduras, Late Classic ball courts were oriented to either the northeast or southeast depending on their spatial location (Joyce and Hendon 2000). Archaeologists believe that the northeast orientation corresponded to the direction of the rising sun in midsummer and the southeast orientation corresponded to the direction of the rising sun in midwinter (Aveni 2001; Joyce and Hendon 2000). These preferences in directionality most likely related to agricultural fertility rites and how the valley occupants viewed their place in the cosmos.

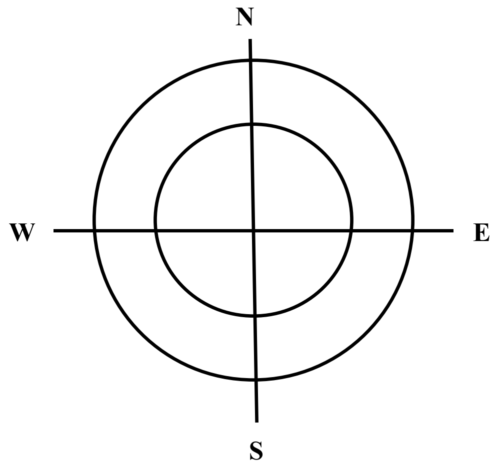


Figure 1.1: **Quincunx diagram (modified from Coggins 1980)**

The east was the “honored position” associated with the rising sun and birth, and the west was associated with the setting sun and death (Coggins 1980). However, the north-south axis represented a vertical dimension, with the north associated with the heavens and the south with the underworld. In fact, unlike the modern Chorti language, references to north (*xaman*) and south (*nohol*) are found on Stela A at Copán (Ashmore 1991). Mayanists, making use of epigraphic, iconographic, and archaeological data, believe that the ancient Maya organized many of their sites according to the cardinal directions using a quadripartite plan (Ashmore 1991; Ashmore and Sabloff 2002, 2003). Originally scholars applied this quadripartite plan only to large civic-ceremonial complexes; however, research over the past two decades indicates that this concept of directionality was replicated at different scales across ancient Maya sites (Ashmore 1991; Houk 1996; Maca 2002). Maca’s (2002) work at Copán indicates that directionality was also important in delimiting the city’s urban boundaries. However, only at the site of La Milpa in Belize have archaeologists investigated whether a relationship exists between the cardinal directions and visibility at ancient Maya cities (Hammond and Tourtellot 1999; Tourtellot et al. 1999).

Studies show that overlapping visual spheres and boundaries between visual domains can help archaeologists to identify spatial templates (such as quadripartite organization), activity patterns, cultural groupings, and communication flow between different social groups and sites (Llobera 2003, 2005, 2006; Maples 2004; Ogburn 2006; Wheatley and Gillings 2000). Therefore, the study described in this dissertation uses measures of directionality (orientation of viewsheds) to identify overlapping visual spheres and visual boundaries in order to investigate whether there is a connection between visibility and cardinality at Copán, that is, to identify whether visual fields correspond to cardinality or replicate the quadripartite pattern seen in other aspects of ancient Maya site planning (Ashmore 1991; Hammond and Tourtellot 1999; Joyce and Hendon 2000; Maca 2002; Tourtellot et al. 2003; Tourtellot et al. 1999). The study also measures directionality to test current hypotheses about the function of Copán's seven valley stelae to determine if Copán's dominant households had separate and distinct visual spheres in order to identify social groups, activity areas, and/or communication flow.

While the directionality data failed to indentify a link between visibility and cardinality, they do suggest that visibility played an important role in communicating information to targeted audiences and structuring social interaction. The data reveal several patterns, indicating that: (1) the valley stelae served multiple functions, ranging from sending targeted messages to the elite to channeling foreigners into the city along a specific route to guiding ritual processions through the valley; (2) intra-community visibility differences reflected distinct social spheres and/or functional differences between dominant households located within the same sub-community; and (3) a subset of dominant households served as seats of power that aggregated people from several sub-communities into a larger community indicative of an intermediate-level interaction sphere. Taken together, the directionality results highlight overlapping and distinct visual spheres that are interpreted to reflect differences in functionality, temporality, and/or ethnicity.

A Multi-Scalar Approach: From the Household to the City

Physical configurations in ancient cities both mirrored and shaped social interaction (Cutting 2003; Moore 2003, 2005). These configurations occurred on many scales, from single households to multi-family architectural complexes to neighborhoods and up to the scale of the city itself (Marcus 2000; Yaegar and Canuto 2000). The benefit of multi-scalar approaches is that they bridge the gap between household and settlement pattern studies and studies oriented toward the elite. By investigating the built environment at many different scales, data about its various components (monuments, roads, residences, reservoirs, and the like) can be collected to inform on how different social groups interacted with one another. Examining all aspects of ancient Maya life is beyond the scope of this dissertation; however, by studying how people positioned themselves on the landscape, critical insight is gained on the degree to which ancient Copanecos of differing social classes may have interacted.

In this research, integration and visibility patterns for five layers of ancient Copaneco society were identified and subsequently analyzed: (1) major household(s) in sub-communities (*sian otots*); (2) sub-communities; (3) the urban core-hinterland; (4) physiographic zones; and (5)the city as whole (valley-wide). These different scales were examined to test whether Copán's social hierarchy was mirrored and shaped by access and visual hierarchies in the built environment that were replicated across the many layers of Copaneco society. The objectives included reconstructing interaction (1) between (rather than within) Copán's 20 *sian otots* to study differences and similarities across sub-communities, (2) between the urban core and its hinterland to study core-periphery relationships, (3) between the valley's five physiographic zones to understand the potential influence of ecological variables on structuring pedestrian movement and object visibility, and (4) in the city as a whole to understand how Copán's different social groups may have interacted across the valley.

Summary

The archaeological site of Copán, Honduras, has a long history of exploration, excavation, and research that provides ideal datasets with which to study how the built environment's configuration reflects and shapes past social interactions. Architectural stratigraphy, hieroglyphic inscriptions, sculptural style, iconography, construction materials, and the formal components of architecture and their configurations are among the many elements that have been used to study the site's architecture (e.g., Abrams 1987, 1994, 1995; Ahlfeldt 2004; Baudez 1983, 1994; Carrelli 2004; Fash and Stuart 1991; Inomata and Houston 2001; Sanders 1989; Schele 1992; Traxler 2004a, 2004b). However, to date no one has employed GIS to study how the city's buildings and bounded spaces were configured to influence interaction between people living at different site types.

Although quite varied, methods to study spatial organization within the built environment at ancient Maya sites have one thing in common: they tend to carry out their investigations on the horizontal plane. They typically analyze flat, two-dimensional site maps leading to a bird's eye view analysis. This unintentionally "flattens" the Maya worldview by compressing their multi-layered cosmos into north-south and/or east-west relations (Bricker 1983). Movement between various areas of a site is often not taken into account, nor is verticality, and consequently methods incorporating intra-site accessibility and visibility into the ancient Maya built environment have not yet been fully developed. This dissertation addresses recent requests to develop empirical approaches to studying urban planning among the ancient Maya (Ashmore and Sabloff 2002, 2003; Smith 2003, 2007). It offers an innovative approach using GIS to evaluate two specific aspects of the built environment, integration (pedestrian movement) and visibility, both of which take part in shaping social interaction. This research offers new information on how Copán's inhabitants interacted and sent messages about social status to one another via the built environment.

Despite such advantages, there are also certain limitations to this research. Although the archaeological site of Copán offers many large and diverse datasets and despite recent efforts to further our understanding of the Early Classic (e.g., Bell et al. 2004), there is still a paucity of information on Early Classic occupations, especially outside of the Principal Group (the sites' main civic-ceremonial precinct). This means that change *through time* in integration and visibility across the entirety of the site cannot be measured, and as a consequence this research is a synchronic study. Regardless of this shortcoming, this approach allows archaeologists to test some common assumptions. For example, scholars typically assume that the city's elite had greater accessibility to the site's Principal Group (i.e., were more integrated); however, this assumption has never been empirically tested. Nor have scholars had the opportunity to test if elite forms are replications of smaller-scale, non-elite forms or if urban forms are replications of hinterland forms, that is, whether social configurations are replicated across the scales of society (Maca 2009).

Thus, by bridging recent GIS methods and social theory via social semiotics this dissertation research is able to show that the Maya living in the ancient city Copán, Honduras, configured their city so as to facilitate communication between people living at different site types. It reconstructs access and visibility patterns between the city's different site types to determine if a spatial hierarchy existed that helped to shape and maintain a social hierarchy. In studying the senders and receivers of messages, this research helps to enrich our knowledge of the ties between social order and site organization at the ancient Maya city of Copán. Moreover, it reveals underlying complexities and sociopolitical relationships pointing to the presence of varying degrees of sociopolitical control within the city, suggesting that rather than thinking of whole systems as centralized or decentralized, archaeologists need to place greater emphasis on internal variation within sociopolitical systems. Given recent technological advances, such a shift is now possible.

Chapter Summaries

Chapters 1, 2, 3, and 4 provide background and set the stage for this dissertation research. Chapters 5, 6, 7, 8, and 9 describe the innovative methodology used and its results. Chapters 10 and 11 bring together these results and interpret their significance, not only for Copán, but for Maya studies and archaeology in general.

Chapter 2 discusses what scholars know about Copán's environment, history, and inhabitants. It brings together, from previous scholarship, both top-down and bottom-up information to create a more complete picture of ancient Copán. The dissertation places the reign of *Yax Pasaj* (at the end of the eighth and beginning of the ninth centuries) in its larger social, political, and environmental contexts to better understand the circumstances that led to the city's final configuration—a configuration that provides clues to ancient social interaction between people living at different site types in the valley. Chapter 3 contextualizes previous research on architecture and space at the archaeological site of Copán. It lays out what we know about the site and how we know it, in order to explain how other researchers have studied architecture and space at Copán. It also sets the stage for explaining how this dissertation offers a new avenue of research on Maya architecture and space. Chapter 4 describes this alternative way of studying architecture and space, and the roles these elements played in structuring ancient Maya social dynamics. The chapter also explains how I integrate the theory of social semiotics with GIS to develop a strong empirical approach toward interpreting how ancient Copanecos may have used access and visibility to shape human interaction.

Chapter 5 defines the methods used to measure access and visibility between different site types, focusing explicitly on how the unique capabilities of GIS make this technology a fundamental component of the methodology. Chapter 6 describes the statistical tests used for measuring access between different site types. It also presents the access results for the four scales analyzed in this study. Chapter 7 describes the statistical tests used for measuring visibility between different site types and presents the visibility results for the four scales analyzed in this study.

Chapters 8 and 9 delve deeper into the role visibility may have played in sending messages to specific groups of people at Copán. Chapter 8 examines whether cardinal relationships, with respect to visibility, exist between Copán's civic-ceremonial center and outlying settlements. It also tests present hypotheses about the functionality of Copán's ancient valley stelae and proposes a new explanation for their purpose. Chapter 9 examines sub-community visibility to determine if Copán's dominant sites targeted different audiences.

Chapter 10 brings together the access, visibility, and directionality results in order to discuss what these data tell us about how Copán's eighth and ninth century inhabitants arranged themselves in the landscape, and what this arrangement says about social structuring. It also proposes a set of testable hypotheses to provide new directions for future research. Chapter 11 focuses on the broader significance and methodological implications of the research presented here, specifically how the methods can be used for comparative studies at other Maya sites and archaeological sites in other regions of the world.

Chapter 2:

Historical, Environmental, and Sociopolitical Circumstances in the Late Eighth and Early Ninth Centuries at Copán

Introduction

During the reign of *Yax Pasaj* (AD 763−822), Copán's inhabitants lived in a society of extraordinary achievements in art, architecture, writing, and astronomy; however, they were simultaneously coping with severe environmental, demographic, and sociopolitical circumstances (Abrams and Rue 1988; W. Fash 2001; W. Fash et al. 2004a; Rue 1987; Storey 1992, 1997; Webster 2002, 2005; Webster et al. 2000; Whittington and Reed 1997). During this time, when the city reached its peak population of 22,000 (Webster 2005), some scholars believe that a power struggle occurred in which the king was forced to "share" some of his power with the city's nonroyal elite (B. Fash et al. 1992; W. Fash 1991, 2001; Stomper 2001). Others, however, disagree. They believe that *Yax Pasaj*'*s* powerbase was relatively strong and that researchers have misinterpreted architectural, iconographic, and epigraphic evidence to represent power dissolution when in actuality it reflects a major urban renewal project on behalf of the ruler himself (Maca 2002; Plank 2003, 2004; Wagner 2000).

The crux of the argument is whether the sociopolitical system was centralized or decentralized during *Yax Pasaj's* rule. William Fash and Barbara Fash (B. Fash 2005; B. Fash et al. 1992; W. Fash 1989, 1991, 2001), among others (Cheek 2003; Riese 1989; Sanders 1989; Stomper 2001), use epigraphic and sculptural data from the Principal Group and outlying suburbs to argue that the alleged capture and decapitation of Ruler 13 by the nearby city of Quiriguá in AD 738 (25 years before *Yax Pasaj's* ascension to power) marked a turning point for Copán's ruling dynasty. They believe that Ruler 13's successor, Ruler 14, was surrounded by uncertainty about the royal lineage's legitimacy, the decapitation sparking questions about royal disfavor with the supernatural. Thus, with his regime marred not only by external strife, but also by internal conflict, Ruler 14 conceded some of his power to other elite lineages within the Copán Valley. This strategy, they believe, was followed by his successors, Copán's 15th and 16th rulers, leading to a more decentralized regime by the end of the Late Classic (W. Fash 1983a; 2001).

In contrast, Maca (2002) and Plank (2003, 2004) contend that *Yax Pasaj* used a different political strategy that rather than appeasing other elites by redistributing power, *Yax Pasaj* made an effort to re-centralize power through a two-part massive construction campaign. One part focused on renovating several monuments in the Principal Group, and the other centered on extending the ruler's reach out into the suburbs through the renovation/construction of several "state-owned" structures. Interestingly, Maca and Plank arrive at similar conclusions using independent lines of evidence. Plank (2003, 2004) used epigraphic and architectural data from the Principal Group and its nearby suburbs, while Maca (2002) focused on architectural stratigraphy and ceramic data from excavations at 9J-5, an elite courtyard group on the outskirts of the city's proposed urban boundary. Their conclusions suggest that much of the suburban architecture used to support the decentralization hypothesis is misattributed to the city's nonroyal elite lineages. They believe, instead, that *Yax Pasaj* renovated several of the city's suburban structures as part of a "purposeful and centrally-directed construction project" (Plank 2004:90), which served the ruler's larger political agenda: emphasizing centralization.

I argue that these two interpretations are not necessarily mutually exclusive. Following the untimely death of Ruler 13, the royal lineage may have experienced waning power that resulted in some degree of decentralization; however, just because Copán's dynasty may have experienced power loss does not necessarily imply that Ruler 16 passively accepted his "fate." Instead, *Yax Pasaj* may have instituted a strategy (an urban renewal project) to curb royal power loss and bring the city's occupants together during a stressful time. In other words, the power structure of Late Classic Copán may have been somewhat decentralized, but *Yax Pasaj* and perhaps other elite (as during this tumultuous time it may have been in their best interest to join forces with the ruler to maintain the status quo) may have implemented a strategy to counter their waning power. Given that measurements of access and visibility provide information on *who* was more likely to interact with *whom* and *who* sent messages to *whom* via architecture, such data may be able to shed light on the processes of sociopolitical organization at Late Classic Copán. By emphasizing the senders and receivers of specific messages, this study's focus is shifted from the centralized vs. decentralized dichotomy to addressing the mechanisms of social control; however, reconstructing these mechanisms and their significance requires considering both the elite and commoner components of ancient Maya architecture and space. It also necessitates understanding the historical, environmental, and sociopolitical circumstances that influenced *Yax Pasaj's* reign and the decisions that he and all members of society made.

Historical Overview

Copán comprises many layers of history, and by means of survey, excavation, and other methods, researchers have been able to deconstruct much of this palimpsest and reconstruct its physical and sociopolitical landscapes at different times in its history (Agurcia Fasquelle 1996; Agurcia Fasquelle and B. Fash 2005; B. Fash 2005; W. Fash 2001; W. Fash et al. 2004b; Stuart 2004; Traxler 2004a, 2004b). Although the period of interest for this case study is AD 763 to AD 822, it is important to understand this period in relationship to the city's broader historical circumstances. Recent work on earlier occupation phases shows that earlier conditions gave rise to many of the institutions, ideologies, and practices that helped to shape Copán's final dynastic phase, both the state of its social, political, and economic affairs and its physical configuration (e.g. Buikstra et al. 2004; Canuto 2004; B. Fash 2004; Sedat and Lopez 2004; Sharer 2004; Sharer et al. 2005; Traxler 2004a, 2004b).

Copán, the largest Maya center in the southeast periphery of the Maya lowlands, is located in the Copán Valley of Honduras about 14 kilometers east of Guatemala. The valley is approximately 12.5 km long and 6 km wide (W. Fash and Agurcia Fasquelle 2005). Settlement within the valley covers approximately 24 square kilometers (Figure 2.1), while the extent of the urban core is estimated to be between one and three square kilometers and is thought to have been the most densely settled in the Maya region (Figure 2.2) (Barnhart 2001). Archaeological evidence indicates that the ancient Maya inhabited the valley for over 2500 years, from circa 1400 BC to AD 1250 (W. Fash 1983a, 1983b; Freter 1988; Hall and Viel 2004; Manahan 2003, 2004; Willey and Leventhal 1979).

Although archaeologists are still investigating the factors leading to the valley's initial settlement (Hall and Viel 2004), it is likely that its high agricultural potential, access to important resources (such as water, construction materials, granite, kaolin, and limestone), and location near major obsidian and jade sources prompted settlement (W. Fash 2001). It is also possible that its location was part of a larger sacred geography (Aveni 2001; Brady and Ashmore 1999). Preclassic pottery types indicate that the valley's earliest occupants had ties with Pacific coastal Guatemala, western El Salvador, and central Honduras (Hall and Viel 2004). While the ceramic data place the arrival of the Maya sometime between AD 100 and AD 250 (Hall and Viel 2004), recent pollen studies suggest that the Maya did not migrate to the valley until circa AD 250 (McNeil 2009). Almost two hundred years later, in AD 426, *Yax K'uk Mo* arrived, a foreign Maya elite and founder of the Copán dynasty, who changed the course of the city's history (Sharer 2004).

In general, much of what we know comes from the top down, that is, from the elite perspective, especially that of the royal elite. However, with the advent of bottom-up approaches, scholars have begun to gather more information on commoners. Together these two perspectives help to paint a more comprehensive picture of ancient Maya life. We begin with the royal perspective.

Early Classic (AD 426−600): From the Royal Perspective

Urban construction, monumental architecture, hieroglyphs, and the rise of the *k'uhual ahau*, or divine kingship, originated in the Preclassic or Early Classic periods, and all played significant roles in Late Classic society (Coe 2005; Freidel and Schele 1988; Schele 1992; Schele and Matthews 1998). One of the most important of these influences, divine kingship, appears to mark the onset of the Early Classic and Copán's longlived dynasty. From its inception, divine kingship played an essential role in ancient Maya ideology and politics because it served, in part, to harness social energy and create a shared model of reality (McAnany 1995; Schele 1992; Schele and Freidel 1990). By bringing people together in this way, it allowed the site's royal lineage to acquire power and to establish dominance over other lineages. This practice not only permeated daily life, but also influenced the construction of buildings and freestanding monuments and the spatial organization of the built environment.

Archaeological evidence indicates that Late Preclassic rulers constructed public monuments displaying narrative scenes and mythical imagery; however, portraits honoring individual rulers are notably absent. Glorifying individuals becomes commonplace only with the rise of dynastic rulers. Freidel and Schele (1988:86) note,

> The historical identities of Late Preclassic rulers have not been found recorded in public space; this suggests that the personal and historical identities of rulers did not require verification in the form of public monuments. Exactly the opposite is true for the Classic period: the legitimization of individual rulers through genealogy and supernatural character in public space with public participation seems to have been the prime motivation for the erection of public art.

Thus, it is during the formative years of the Early Classic that Copán's rulers begin to erect freestanding monuments depicting themselves, and excavations of structures and burials reveal a large investment in Copán's Principal Group at this time (Baudez 1994; Leventhal 1981; Sanders 1986, 1989; Sedat and Lopez 2004; Traxler 2003; Webster et al. 2000).

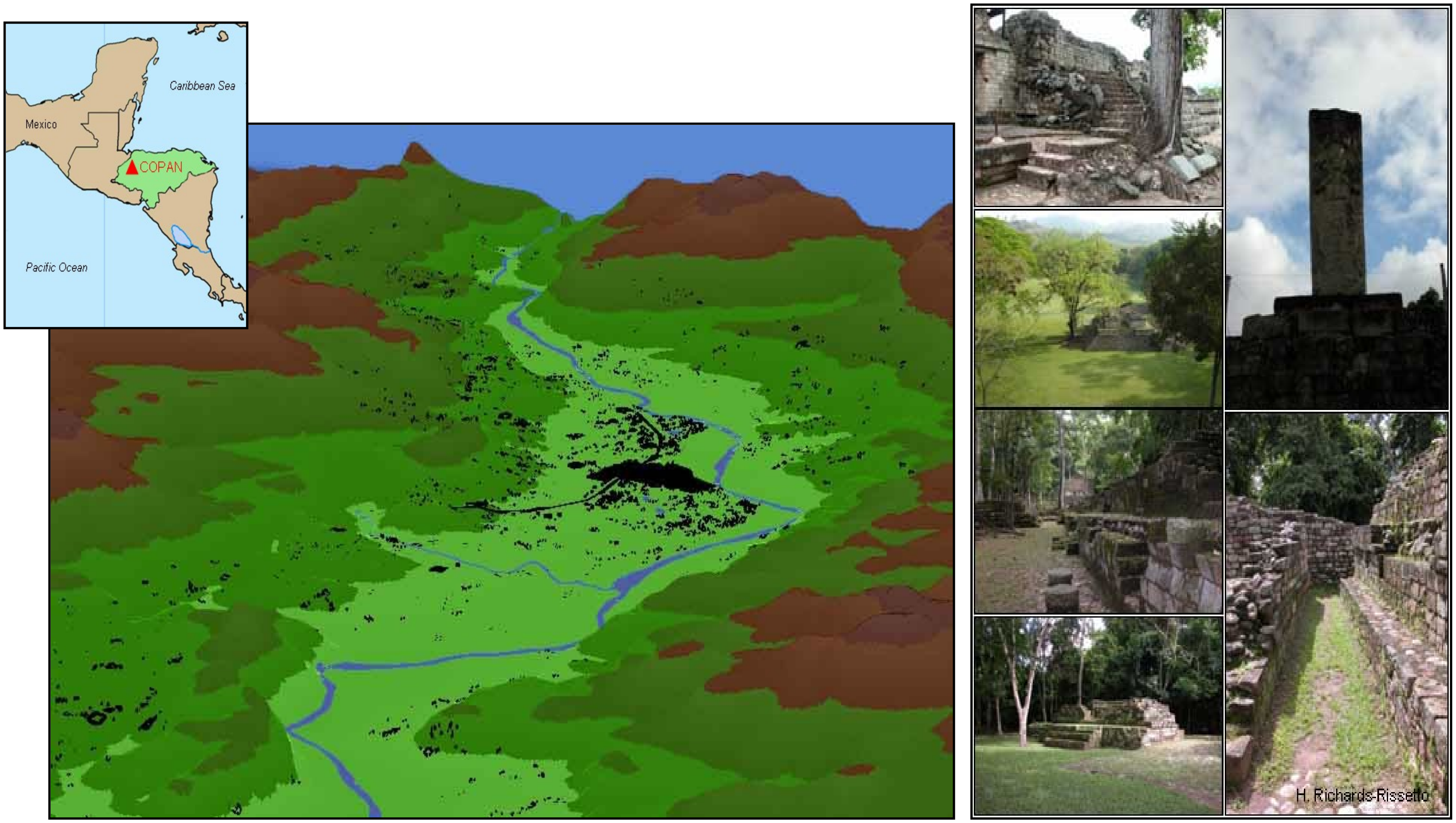


Figure 2.1: **Location (left) and archaeological ruins (right) of Copán, Honduras (Richards-Rissetto 2007*)***

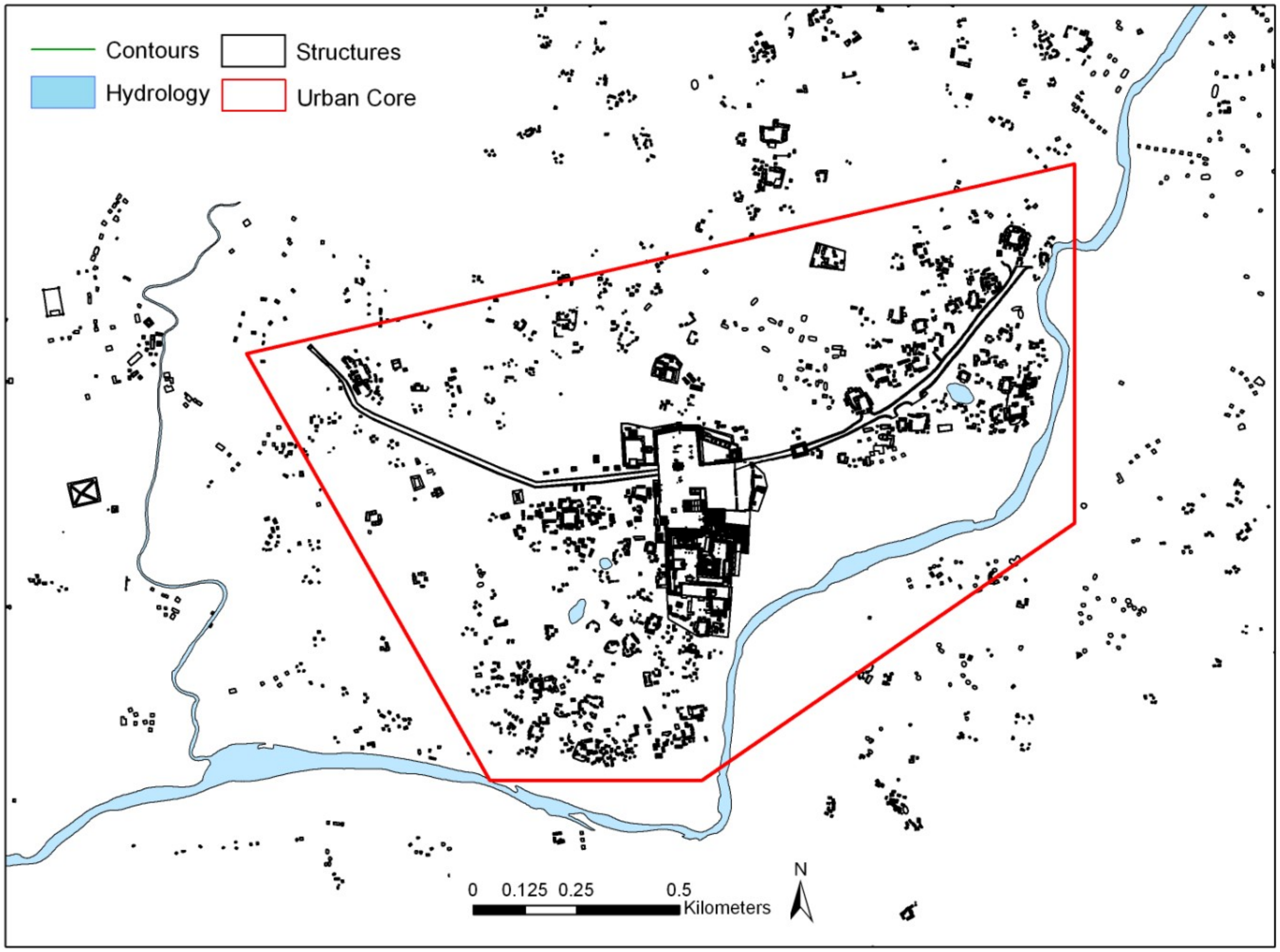


Figure 2.2: **GIS Map of Late Classic Copán's densely populated urban core (Richards-Rissetto 2008*)***

In AD 426 *K'inich Yax K'uk'Mo'*, the founder of Copán's royal lineage, set out to mark the new dynasty by initiating a large-scale construction campaign at the site's center (W. Fash and Stuart 1991; Schele 1992; Sharer 2004; Sharer et al. 2005; Stuart 1992, 2004). Tunneling excavations indicate that striking changes continued to take place at the Principal Group as Copán's rulers erected more monuments and structures, often constructing them atop older buildings (e.g. B. Fash et al. 1992; B. Fash et al. 2004; Sharer 2004; Sharer et al. 2005; Traxler 2004a, 2004b). These recently uncovered data on Early Classic architectural stratigraphy and sculpture help to set the stage for the social dynamics and power negotiations seen in the Late Classic.

Late Classic (AD 600–822): From the Royal Perspective

The Late Classic was a period of florescence for the Maya; however, it was also a time in which they coped with mounting problems (W. Fash 2001). While, like other southern lowland Maya, Copán's inhabitants were making extraordinary achievements in astronomy, architecture, and writing, they were simultaneously facing environmental degradation, warfare and competition, political disruption, and ideological disintegration (e.g., Abrams and Rue 1988; W. Fash 2001; W. Fash et al. 2004a; Rue 1987; Storey 1992; Webster 2002, 2005; Webster et al. 2000; Whittington and Reed 1997). It is this combination of florescence and decline that makes the Late Classic an ideal time period to investigate social interaction. This is especially true for the end of the Late Classic (AD 763–820) at Copán, when we see striking changes made during the reign of the city's final dynastic ruler.

From AD 650 to 900 Copán's population grew dramatically, more than quadrupling in 250 years, but this boom was followed by rapid population loss circa AD 900−950 (Webster 2005). The stress placed on Copán's local environment because of rapid population growth and decline over such a short period is one factor that contributed to changing social dynamics in the Late Classic. During this time Copán's inhabitants also saw six dynastic rulers ascend to power (Table 2.1). Epigraphers have deciphered many of the site's inscriptions and dates and created a chronology of dynastic rulers. Archaeologists have compared these data to architectural strata in order to assign construction campaigns to specific rulers and describe how the accession and death of each of these rulers resulted in change (e.g., Agurcia Fasquelle 2004; W. Fash 2001; Sharer 2004).

Table 2.1: ***Late Classic rulers at Copán and monuments erected or renovated in their reigns (compiled from W. Fash 2001)***

Ruler	Reign	Monuments	Structures
Ruler 11	AD 578 - 628	Stelae 7, 18, P; Altar Y	Renewed 10L-26, 10L-11, Ballcourt A
Ruler 12	AD 628 - 695	Stelae 1, 2, 3, 5, 6, 10, 12, 13, 19, 23, I Altars H',I', K	Major remodeling of Acropolis
Ruler 13	AD 695 - 738	Stelae A, B, C, D, F, H, J, 4 Altar S	10L-2, 10L-4, 10L-9, 10 (Ballcourt A-III), 10L-22, 10L-26 3rd. first Hieroglyphic Stairway
Ruler 14	AD 738 - 749		10L-22A (*Popul Na*)
Ruler 15	AD 749 - 763	Stelae M, N	Refurbishes Hieroglyphic Stairway Temple of Structure 10L-26 1st
Ruler 16	AD 763 - 820	Stelae 8, 11; Altars F', G1, G2, G3, D', O, Q, R, T, U, V, Z, inscribed stone on 10L-22A	10L-11, 10L-16, 10L-18, 10L-21A

One of the most conspicuous of these changes was the repeated configuring and reconfiguring of the site's main ceremonial complex, the Principal Group. These massive construction projects not only transformed the Principal Group, but more importantly they changed the face of the city's entire landscape. Recent research at Copán has raised new questions about the nature, purpose, and meaning(s) of these reconfigurations, especially the site's very last reconfiguration, which was commissioned by the site's sixteenth and final dynastic ruler, Y*ax Pasaj*, at the end of the Late Classic (Maca 2002; Plank 2004). A brief history of each ruler's construction campaigns is described here in order to provide context for current interpretations about the site's changing sociopolitical arena.

During the early years of the Late Classic (AD 578−628), Copán's 11th ruler, *K'ak' Joplaj Chan K'awil*, erected three stelae, an altar, and a ball court, and renewed two structures. These monuments record his birth and accession dates and describe his performances for specific ritual events. His successor, Ruler 12 (*Smoke Imix*), documented his lengthy reign on numerous freestanding monuments inscribed with references to genealogy, astronomy, the creation of the universe, and bloodletting and dedication ceremonies. Seven of the stelae attributed to his reign were erected in the valley and only two in the Great Plaza (W. Fash 1983a, 2001). It is believed these widely dispersed monuments represent an attempt to consolidate power, which he does by targeting valley residents with a message of his glory and legitimacy (W. Fash 1983a).

Copán's 13th ruler, *Waxaklajun Ub'aah K'awil*, built several new structures and erected a large number of monuments, most of which reference genealogy, rulership, astronomy, and supernatural forces. His reign, however, was cut short. At the nearby site of Quiriguá epigraphers have deciphered an inscription, dated to AD 738, in which a rival (*K'ak'Tiliw*) claims to have captured and decapitated Ruler 13 (W. Fash 2001). His death most likely resulted in power loss for Copán's royal lineage by sparking uncertainty about the royal lineage's legitimacy. His successor, the 14th ruler, known as *K'ak' Joplaj Chan K'awil*, was most likely forced to cope with not only external strife, but also internal sociopolitical unrest (W. Fash 2001). No freestanding monuments have been recovered from his reign and he is believed to have built only one structure, 10L-22A, the *Popol Nah*. Several researchers believe that the structure's iconography indicates that it served as a *mat* house, or council house, where the leaders of elite lineages met with the ruler to govern the polity (Cheek 2003; B. Fash el al. 1992; W. Fash 2001; Stomper 2001). They contend that the building's façade display nine toponyms that refer to actual locations in the valley. In this scenario, Ruler 14 decentralized rulership in order to obtain support from community leaders living at these nine locations (W. Fash 2001). Other scholars, in contrast, contend that the inscriptions found on the façade of the *Popol Nah* refer to supernatural places, thus Structure 10L-22A was not a council house and cannot be used to support decentralized rulership (Plank 2003, 2004; Wagner 2000).

Copán's 15th ruler, *K'ak' Yipyaj Chan K'awil*, ruled only for about ten years before his death; however, in this relatively short period of time, he managed to refurbish the Hieroglyphic Stairway, construct a temple at its apex, and erect two stelae. Some scholars believe that Ruler 15 focused on the Hieroglyphic Stairway, a structure glorifying Copán's dynastic history, in an attempt to re-establish power and legitimize his right to rule by referencing his royal ancestry (W. Fash 2001).Given that many of his inscriptions depict scenes of warfare and sacrifice that have been interpreted to signify increasing competition among the city's elite, perhaps this interpretation is correct (Miller and Houston 1987; Sanchez 1997).

Yax Pasaj Chan Yopat, the 16th and final ruler of the founding dynasty, rebuilt many of the structures on the Acropolis, erected two stelae, and commissioned numerous altars in what many interpret as a last attempt to maintain power. His monuments depicted motifs similar to those of his predecessors, including imagery of the cosmos, genealogy, astronomy, and warfare. However, as noted above, two very different hypotheses about centralized vs. decentralized power and strategies to maintain and/or re-establish power are currently debated.

Most of Copán's dynastic inscriptions depict a flourishing society ruled by venerable kings supported by powerful ancestors and supernatural forces; however, such claims of uncontested power are often contradicted by the archaeological record, which suggests that as the Late Classic period unfolded, population growth, deforestation, and soil erosion led to increasing economic hardship and sociopolitical strife (Abrams and Rue 1988; Lentz 1991; Rue 1987; Storey 1992; Webster 2002). In order to create a more holistic understanding of ancient Copaneco society it is necessary to look beyond epigraphic and iconographic data to other sources, especially those from settlement pattern surveys, which include both top-down and bottom-up perspectives. The remainder of the chapter focuses on four analytical scales—physiographic zones, urban core-hinterlands, sub-communities (*sian otots*), and sites (patio groups)—that archaeologists use to investigate environmental and sociopolitical factors at Copán.

Late Classic Settlement Patterns: Top-Down and Bottom-Up Perspectives

Robert Burgh, assistant to John Longyear of the Carnegie Institution, carried out the first official settlement survey of the Copán Valley between 1935 and 1946 (Longyear 1952). However, it was not until the late 1970s that archaeologists of the Harvard University−Copán Valley Project began a series of intensive settlement pattern surveys whose goals were to (1) document the region's physiographic zones, (2) describe settlement, and (3) create a general typology of architectural groups that could be used for comparative studies across the valley (W. Fash 1983a; Leventhal 1979; Willey and Leventhal 1979; Willey et al. 1978). Using data from these surveys, archaeologists have studied the valley at five different scales: valley-wide, physiographic zones, urban core-hinterlands, *sian otots*, and patio groups (referred to as sites at Copán) (Figure 2.3). The valley comprises five physiographic zones, an urban core with surrounding hinterlands, twenty-one *sian otots*, and an estimated 600 patio groups.

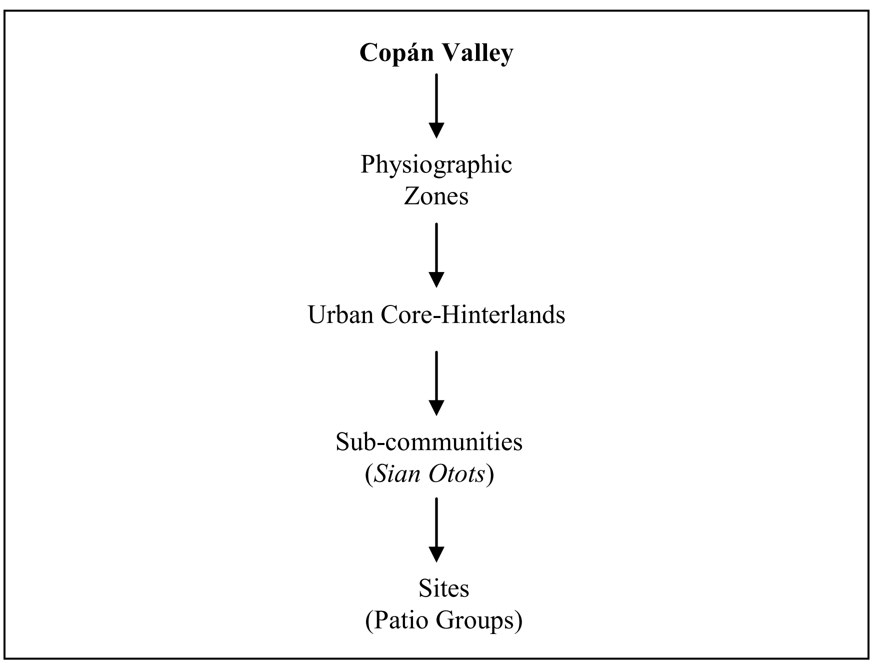


Figure 2.3: **Schematic representation of scales of analysis in Copán Valley**

Physiographic Zones

Using ecological and archaeological data (soils, vegetation, and landforms), archaeologists and other scientists (Baudez 1983; W. Fash 1983a; Leventhal 1979; Turner et al. 1983; Willey and Leventhal 1979) divided the valley into five physiographic zones: Zone 1 (modern floodplains), Zone 2 (low river terrace north of the river, east half of the valley), Zone 3 (foothills north of river, east half of pocket), Zone 4 (foothills, high and low river terraces south of river, east half of pocket, and Zone 5 (west half of pocket) (Figure 2.4).Only two types of soil (*entisols* and *inceptisols*) are present in the valley. As for vegetation, conflicting paleo-environmental data suggests two different scenarios for the Late Classic period. Pollen studies from the 1980s indicated that 85% of the valley was deforested. Elliot Abrams and David Rue (1988:391-392) write that "no pine would have been standing for the entire 12 km length of the Copan pocket for a distance of nearly 1.0 km away from any zone of settlement of either side of the Copan River." More recent pollen studies suggest that there was "not a crisis of deforestation in the Late Classic" (McNeil 2009:56); however, given that the pollen samples from both studies were extracted from the same source (the Petapilla pond) and yet led to contradictory conclusions, the degree and nature of deforestation is still undecided.

Zone 1

Zone 1 occupies the modern floodplains and is devoid of archaeological remains. The lack of sites may be due to either or both of two factors: (1) the ancient Maya did not build structures in this area; (2) alluvial deposits from the Copán River have buried or destroyed any prehistoric structures. The first scenario is more plausible for the east and west parts of the valley, while the second is most likely for areas adjacent to the urban core. It is possible that the ancient Maya imposed building restrictions in high-yield agricultural areas. However, by the end of the Late Classic the scarcity of land in the densely populated urban core probably necessitated settlement on these previously prized agricultural lands (W. Fash 1983a).

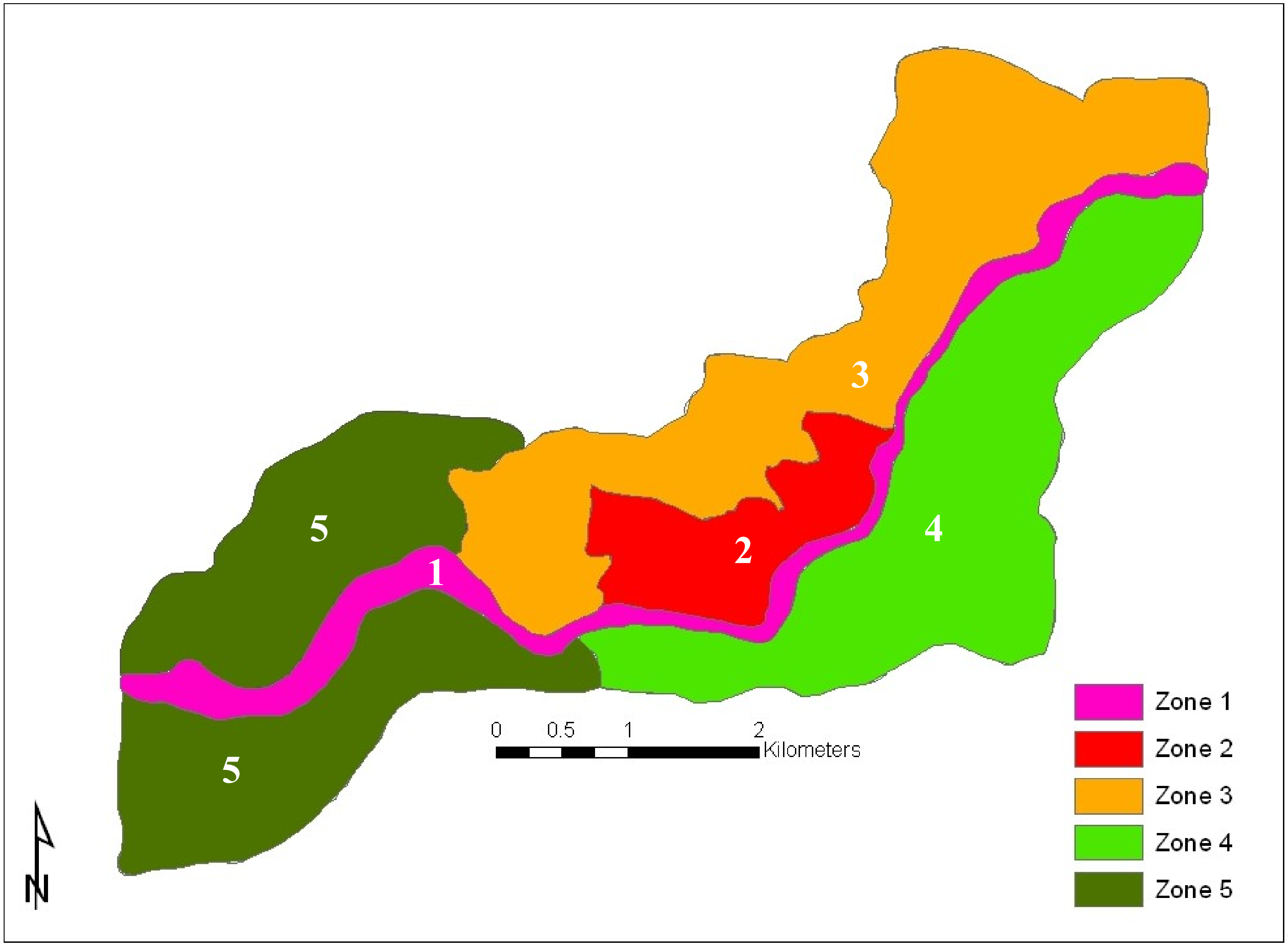


Figure 2.4: **GIS map of Copán's five physiographic zones based on Willey and Leventhal (1979) (Richards-Rissetto 2008)**

Zone 2

Zone 2 occupies the low river terrace north of the river in the east half of the valley. This zone comprises three *sian otots*—Las Sepulturas, El Bosque, and the Principal Group—and is the most densely settled area of the site, with 516 structures per square kilometer making up much of the urban core. It also is the area with the greatest longevity, with occupation dating back to the Early Preclassic (Hall and Viel 2004). Although the area contains all five of the valley's site types, it houses a majority of Copán's type 3 and 4 sites, suggesting that many of the city's elite lived in the urban core. Archaeologists believe that these elite, along with the ruler, controlled not only the distribution of valuable goods such as obsidian, jade, and polychrome pottery, but also many of the valley's agricultural resources (Leventhal 1981). In contrast, individuals living at type 1 and 2 sites probably supported the urban elite, working as domestic servants or craft specialists. Interestingly, the percentage of type 1 sites is lower in Zone 2 than in other zones, suggesting that commoners living near the urban elite had greater access to economic resources than those living in the hinterlands where there are many more type 1 sites.

Zone 2 also contains the site's large civic-ceremonial complex, the Principal Group, which is organized in three parts: the Great Plaza, the Acropolis, and the Royal Courtyard. Scholars believe that the ruling elite held ceremonies that were open to the public, both commoners and elite, in the open spaces of the Great Plaza. In contrast, the more enclosed spaces of the Acropolis were the location of more private events took place. It was probably in the buildings and courtyards of the Acropolis that the ruler met with lesser nobles, both foreign and local, and held smaller, more inclusive ceremonies.

Archaeological and epigraphic data indicate that during the 16^{th} ruler's reign the south end of the Principal Group housed the Royal Courtyard, which included not only the king's domicile, but also those of lesser kin, servants, and perhaps even slaves (Andrews and Bill 2005; Collins 2002). In general, this zone appears to have supported urban elite along with their lesser kin, servants, and/or slaves, who lived in close proximity to the site's major civic-ceremonial complex and its ruler. This close proximity suggests that these elite may have played important roles such as scribes, priests, or craft specialists in Copán's royal court (Traxler 2001; Webster 2001).

Zone 3

Zone 3 occupies the foothills north of the river in the east half of the valley. It supports eight *sian otots*: El Pueblo, Comedero, Salamar, Chorro, Rastrojon, Mesa de Petapilla, Bolsa de Petapilla, and Titoror—all of which appear to have developed around some sort of water source such as a *quebrada* or spring (Leventhal 1979). Although occupation appears not to have been as long and continuous as in Zone 2, archaeological evidence suggests that some sites date back to the Middle Preclassic, indicating a relatively long occupational history in the central and eastern parts of the valley (W. Fash 1983a). Despite a somewhat dispersed and scant occupation in the Preclassic and Early Classic periods, by the Late Classic the area was relatively densely settled, suggesting that it was eventually overtaken by urban sprawl (Leventhal 1981). Even so, much of the area is believed to have been used for farming.

Many of the Zone 3 sites were built on the natural terraces of foothills; however, there is some archaeological evidence for artificial terracing at some of the larger, more complex sites (Leventhal 1979; Maca 2002). The possible reasons for the ancient Maya to expend time, energy, and resources to transform the natural landscape are threefold: (1) to create a façade of wealth, (2) to attempt to increase quantity of level land in vicinity of house units to make more space for kitchen gardens, and (3) to create walkways between sites in different parts of foothills, “facilitating movement within the hills and perhaps connecting family units” (Leventhal 1979:162; Maca 2002). Although all three of these arguments are valid, currently available archaeological evidence supports only the first two interpretations. (Archaeologists would need to carry out additional excavations to test the third hypothesis.) The first possibility—to create a façade of wealth—is further supported by the fact that within individual sites the ancient Maya often placed the largest structure at the back of the terrace against a natural foothill, “thus creating the illusion of a great man-made structure” (Leventhal 1979:148) (Figure 2.5). By making such structures “larger than life,” the inhabitants living at such sites made themselves more conspicuous, suggesting that they intentionally used visibility to send a message of status, power, and wealth.

The region contains two stelae, Stela Petapilla and Stela 13. Stela Petapilla is located in the sub-community of Mesa de Petapilla, about 260 kilometers above the river, while Stela 13 is located in Titoror at the narrow entrance to the valley, about 60 kilometers north of the Río Copán. While both stelae are believed to have been loci for ritual activity, archaeologists hypothesize that Stela 13, erected by Copán’s 12th ruler, also served to mark the eastern boundary of the site (W. Fash 1983a, 2001).

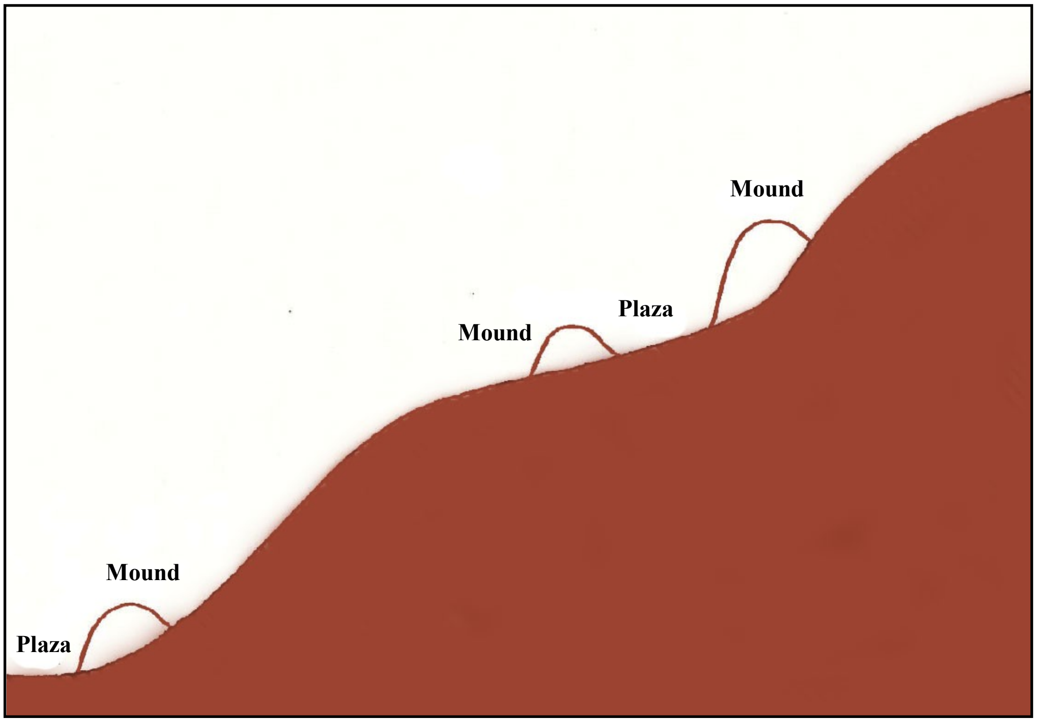


***Figure 2.5:* Cross section of "larger than life" structures in foothills (modified from Leventhal 1979)**

In general, Zone 3 appears to have supported individuals of all walks of life both commoners and elite, both urban and rural, who worked the land and possibly carried out some type of craft specialization (e.g., quarrying tuff) (W. Fash 1983a). The sites seem to have been organized to facilitate people viewing their neighbors and interaction among households (Leventhal 1979). In this way, the region's settlement pattern differs from its southern neighbors living in Zone 4.

Zone 4

Zone 4 occupies the foothills and high and low river terraces south of the river in the east half of the pocket. It comprises four *sian otots*: El Puente, San Lucas, San Rafael, and Titichon. Although the region's rugged terrain appears to have restricted settlement, its bottomlands and lower terraces contained some of the valley's most productive agricultural lands. The presence of cobbled agricultural terraces and two *aguadas* (watering holes) connected by a stone-lined canal indicate that the region was used for farming (Turner et al. 1983); however, whether this use extends into prehistory is debated. A distinct settlement pattern in which “sites seem to be oriented towards land more than people” further supports the belief that this area primarily served agricultural purposes (Leventhal 1979). This pattern is unique to this zone and suggests a different socioeconomic organization for this part of the valley. Interestingly, the area contains only type 1 and 2 sites, which according to the Harvard Typology means that only commoners or people of lower socioeconomic status lived here. However, the elaborate nature of some type 2 sites suggests that perhaps these sites are misclassified.

As for monumental architecture, the zone boasts Stela 12, erected by Ruler 12, high on the hillside at the edge of the sub-community of San Rafael. Its position at the southeast boundary of the valley suggests that like Stela 13 (in Zone 3) it may have marked Copán’s territorial boundaries. However, its alignment with Stela 10, which is positioned in the west part of the valley to have the sun set over it during the vernal and autumnal equinoxes, implies that it may also have functioned as a seasonal marker signaling to the ancient Maya when to begin growing and harvesting crops (Morley 1920). In general, the settlement patterns of Zone 4 indicate that the inhabitants of this region played a different role in the organization of the city than those living in zones 3 and 4 (W. Fash 1983a; Leventhal 1979).

Zone 5

Zone 5, occupying the west half of the valley, is ecologically diverse and consists of several landforms, including floodplains, high river terraces, foothills, and an intramountain pocket. However, it is also the zone with the shortest and most punctuated occupation sequence, with habitation only in the Middle Preclassic and Late Classic periods (W. Fash 1983a). The region comprises six *sian otots*—Yaragua, Ostuman, and Rincon del Buey on the north side of the Copán River, and Tapescos, Estanzuela, and Algodonal on its southern shores. The area contains only one type 4 site in the sub-community of Ostuman and four type 3 sites, two north of the river and two to the south. The bottomlands exhibit some of the best agricultural land in the valley, which is most likely the reason they appear to be devoid of archaeological sites (Leventhal 1979). In fact, for three reasons archaeologists believe that much of this area was set aside for farming purposes: (1) the land was not densely occupied, (2) ancient settlement was oriented primarily toward open terrain rather than neighbors, and (3) ancient settlement distribution is analogous to modern settlement and land usage, which is predominantly agricultural (Leventhal 1979).

The region has two stelae, Stela 10 and Stela 19, located at the far west end of the valley. Stela 10 is on a hilltop overlooking Ostuman, while Stela 19 is actually outside the valley proper, in a small community known as Hacienda Grande. Researchers believe that Stela 10, erected by Ruler 12, served as a territorial marker (like Stelae 12 and 13). In contrast, Stela 19 is believed to have served a different function because it is the only one of the valley-boundary stelae that is located within a sub-community rather than in the outskirts (Leventhal 1979).

Summary of Physiographic Zones

Archaeologists and other scientists combined ecological and archaeological data to divide the Copán Valley into five physiographic zones. Each of these regions exhibits unique differences in archaeological settlement patterns that provide clues to Late Classic socioeconomic organization. Zone 2, located in the central part of the valley and housing the site's main civic-ceremonial complex, is the most densely settled and contains the largest number of type 3 and 4 sites. The large, and complex households are believed to have been occupied by Copán's elite, whose close proximity to the Principal Group, suggests they may have played important roles in the city's royal court (McAnany and Plank 2001; Traxler 2001, 2003). It appears that the southern half of Zone 3 was an urban extension, and although not as densely populated as the urban core its relatively contiguous settlement suggests that it served primarily as residential suburbs. In contrast, both settlement and archaeological data from Zones 4 and 5 indicate that they served predominantly agricultural purposes. Together these data suggest that people living in different areas of the valley played distinct socioeconomic roles in Late Classic Copaneco society, which most likely means that they interacted in distinct and unique ways, but the question remains—*does the spatial configuration of these zones reflect and/or reinforce such differences?*

Urban Core and Hinterlands: Boundaries and Sociopolitical and Economic Roles

Copán's settlement data also provide insight into core-periphery relations. Until recently, most archaeologists delineated the urban core as the Principal Group, El Bosque, and Las Sepulturas (e.g. Leventhal 1979; Willey and Leventhal 1978). However, research by Allan Maca (2002) provides convincing evidence that these boundaries should be expanded to include the sub-communities of Comedero, Salamar, and Chorro. Figures 2.6 and 2.7 show the difference in size between the proposed areas. Early archaeologists drew the boundaries based on the etic concept of settlement density (Webster 1985), while Maca's (2002) more recent work uses emic notions of space and other archaeological data to delineate them.

Maca argues that the Late Classic Maya delimited Copán's urban core using a *quincunx* pattern. There are five cardinal places in Maya cosmology that often have physical manifestations in the landscape (e.g. Ashmore 1986, 1991; Baudez 1991; Coggins 1980; Hanks 1990). For example, in contemporary Maya communities cardinally located entry points are frequently marked by crosses, while town centers are marked by crosses or churches (Sosa 1985), and at ancient Maya sites civic-ceremonial centers and even household courtyard groups often exhibit quadripartite divisions and central loci (Ashmore 1991; Ashmore and Sabloff 2002). Following this line of thought, Maca posits that the boundary of Copán's urban core is marked by four monumental U-Groups, a distinct and high-status type of ancient Maya architecture (Tourtellot 1988), one at each of the cardinal directions, and by U-group 10L-1 in the Great Plaza of the Principal Group.

Archaeological evidence from two of these U-Groups (9J-5 and 9N-8) (Figure 2.8) indicates that they were reshaped into U-Groups circa AD 780 in the 16th ruler's reign. Even without excavation data from the other two U-Groups, the 9J-5 and 9N-8 data are enticing and provide some support for Maca's argument that these five groups may have been constructed and/or reshaped as part of an urban renewal project at the end of the Late Classic. Given that Maca's research delimits the urban core using a more emic viewpoint than the one on which the original boundaries were based, this dissertation follows his reasoning (Sanders and Webster 1981; Webster et al. 2000).

Excavations and survey data from the urban core indicate that this area is the oldest, densest, wealthiest, and most complex part of the site (W. Fash 1983a; Hall and Viel 2004; Hendon 1987). The sub-communities in this area appear to be predominantly residential, consisting of patio groups with dwellings, small buildings, and platforms used for domestic duties such as cooking and storage, and a few temple-like structures that may have served civic-ceremonial purposes (Ashmore 1991; Hendon 1987; Maca 2002). The greatest numbers of type 3 and 4 sites are found here, suggesting that many of the city's elite chose to live in the urban core. Moreover, many of these large and elaborate groups were built along or close by the site's east and west *sacbeob*, possibly reflecting a need to be in close contact with the ruler, who lived at the Principal Group, or a desire to conspicuously show their wealth. Some archaeologists have suggested that the urban elite were part of the royal court, playing roles such as scribes, priests, and even craft specialists (e.g., textile workers) (McAnany and Plank 2001), while lesser kin, servants, and/or slaves supported them by carrying out domestic duties and producing everyday utilitarian wares. Others believe that these urban elite acted as landlords watching over their vassals, who grew maize and other crops on their behalf in the hinterlands (Webster 2005).

The archaeological and survey data indicate that much of the hinterlands were dedicated to agricultural production; however, it also suggests that some of the poorer families living in hinterlands may have turned to part-time craft specialization at the end of the Late Classic (Freter 2004). The presence of obsidian tools in some areas (Mallory 1984) and ground stone tools in areas adjacent to rhyolite (Spink 1983) may be evidence of craft specialization.

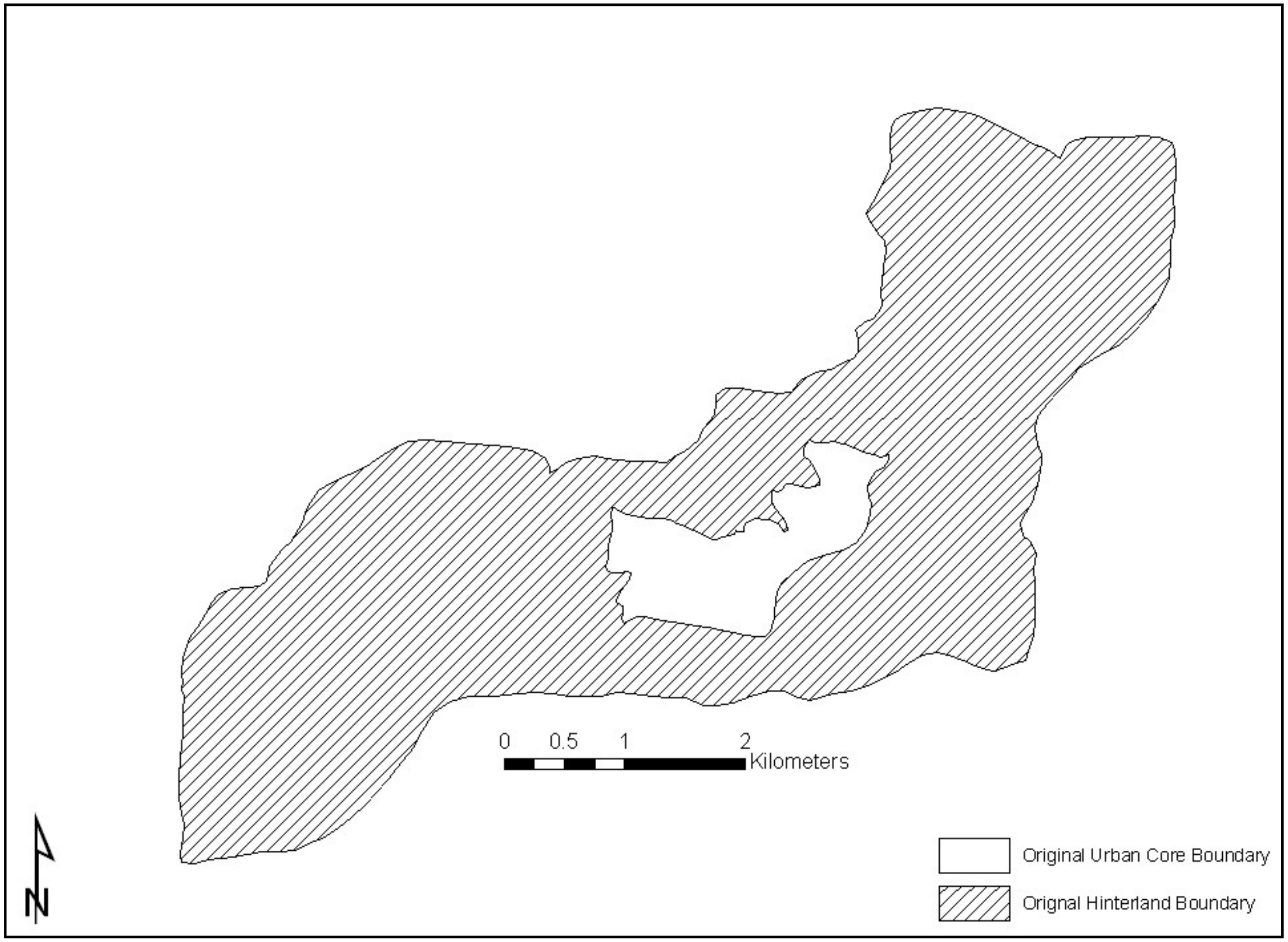


Figure 2.6: **GIS map of Copán's original urban core−hinterland boundaries (Richards-Rissetto 2008)**

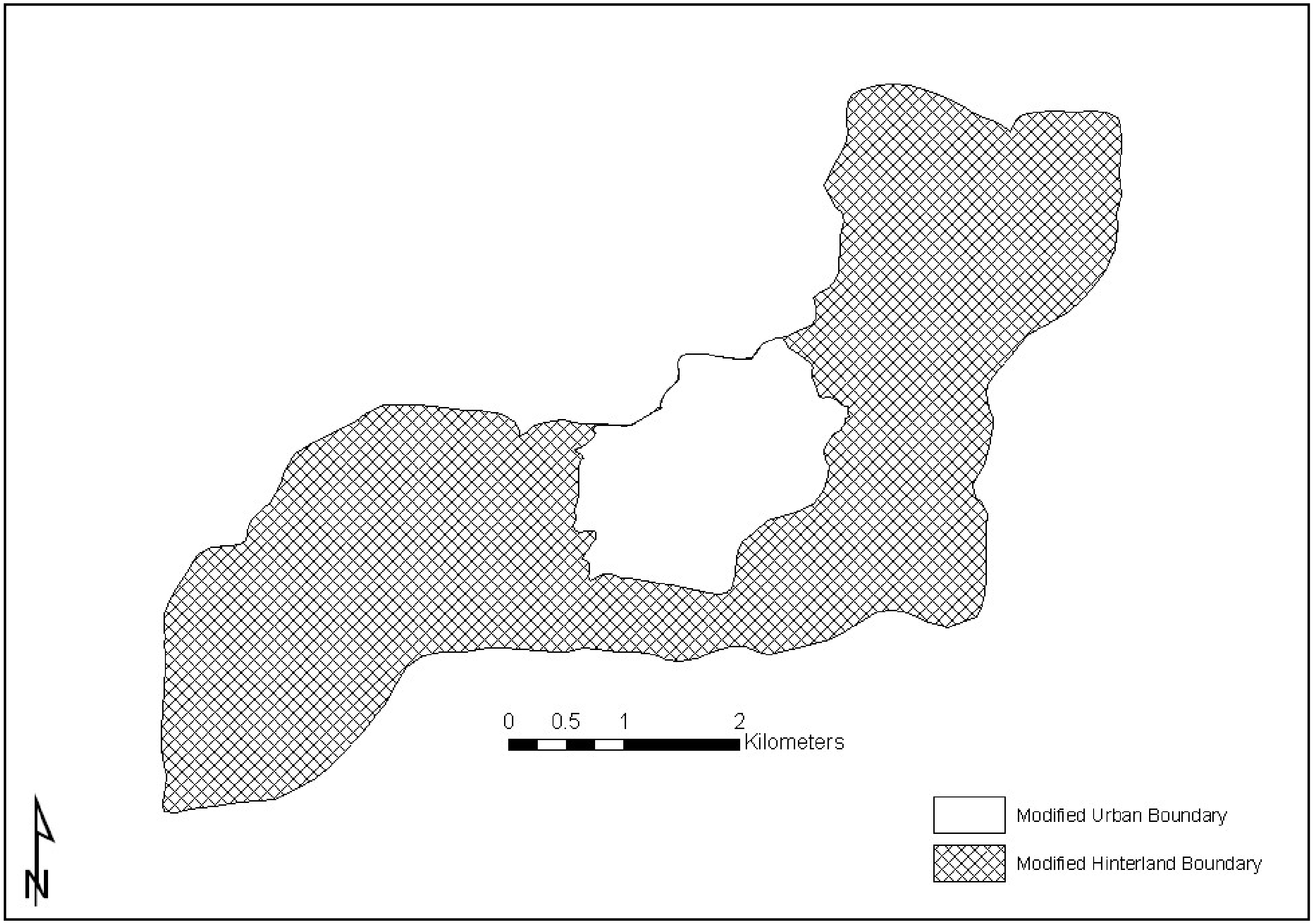


Figure 2.7: **GIS map of Copán's modified urban core−hinterland boundaries (Richards-Rissetto 2008)**

In general, residents of the urban core appear to have been wealthier than families in the hinterlands as they lived in larger, more complex households.

In terms of population differences, during the Late Classic period the average number of structures per square kilometer in the urban core was 414.55, and much higher than the 127.96 structures per square kilometer in the hinterlands. The population during *Yax Pasaj's* reign is estimated at 22,000 people (Webster 2005), with over half (11,868 persons) of the city's residents living in the urban core. Copán's urban density would thus have been at least three to five times greater than that of any other Classic Maya city (Barnhart 2001). When looked at as a whole, the hinterlands do appear to be much less densely populated. However, when examined at a finer scale (the sub-community level), a wider range of Late Classic settlement patterns differing in density, longevity, and wealth, begins to surface.

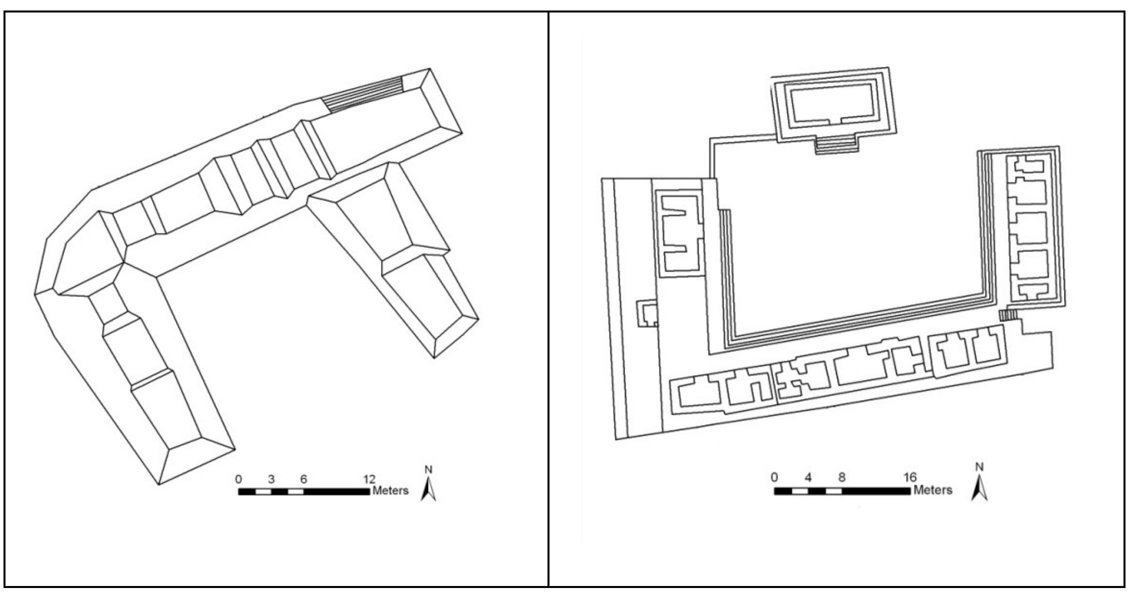


Figure 2.8: **U-Group 9J-5, Comedero (left) and U-Group 9N-8, Las Sepulturas (right)**

Copán's Sub-Communities

Although Copán's internal organization does not mirror other Late Classic centers, the nature of its sociopolitical organization seem to have been similar to the general pattern. Archaeologists have proposed several models to explain how the Late Classic Maya organized themselves. Over the years, the most widely accepted of these models have been the feudalism, regal-ritual, galactic polities, pilgrim-fair, and cargo models (Demarest 2004; Freidel 1981; Sanders and Webster 1988; Vogt 1969, 1983). Of these five, the cargo model seems the most plausible (Barnhart 2001).

Originally posited by Evon Vogt (1969), this model compares contemporary and ancient Maya settlement patterns. The cargo system, used in many contemporary Maya communities, involves the wealthiest member of the community serving as the "cargo holder," who is responsible for hosting ceremonial events in the community center (Barnhart 2001; Vogt 1969, 1983). Full-time religious specialists, or priests, live in the center of each community and the community's families are organized around a central household of higher socioeconomic status surrounded by a cluster of less wealthy residences. In the Highlands of Guatemala and Chiapas such communities are referred to as *snas* and as *sian otots* (literally "many houses"), or aldeas among the Chorti Maya of eastern Guatemala (W. Fash 1983a, 1983b; Vogt 1983; Wisdom 1940). Edwin Barnhart (2001) has recently noted a similar settlement pattern for the ancient Maya site of Palenque in Chiapas. Archaeologists working at other ancient Maya sites (e.g., Dzibilchaltun and Tikal) have also noted the presence of internal divisions or clusters, which they refer to as wards or neighborhoods (Haviland 1981; Kurjack 1974; Kurjack and Garza T. 1981). A similar pattern has also been identified at Copán (W. Fash 1983a, 1983b; Leventhal 1979). However, whereas both modern-day Maya communities and the ancient communities of Palenque typically comprise 12-15 patio groups, Copán's *sian otots* exhibit greater diversity, with the number of patio groups per *sian otot* ranging from 10 to 56 (Baudez 1983).

Despite these slight differences, the similarities between contemporary Maya and Copaneco settlement patterns seem to support the notion that if Copán's inhabitants did not conform exactly to the cargo model, perhaps they at least organized their communities in a similar fashion, with people of lower socioeconomic status centered on wealthier, more dominant households. This pattern was first identified by Richard Leventhal (1979), who noted the existence of "quebrada sections" in the east half of the valley. He argued that these *quebradas* served as natural boundaries between different settlements in the valley. He also noted that each *quebrada* section appeared to have a single site much larger in size and volume than its surrounding sites that he believes functioned as a "control point" for nearby sites (Leventhal 1981). Defining a "cluster" as an architectural unit grouped around one or two dominant sites as his criterion, he identified eighteen clusters in the valley. This number was later increased to twenty-one by William Fash (1983a), who was the first to note the similarities between modern Chorti *sian otots* and Copán's clusters.

Using Charles Wisdom's ethnographic work of the 1940s, Fash (1983a) refined Leventhal's argument. He sees the Chorti Maya *sian otots* as offering a more appropriate analogy than the *snas*. Modern *sian otots* are discrete geographical units that typically consist of 60 to 80 "self-sufficient" households(more closely approximating Copán's clusters), each of which has a house and associated structures, including a kitchen, sweathouses, granaries, storage houses, and animal coops (Wisdom 1940:18). Most noteworthy is the presence of a "chiefly" household that typically exhibits higher socioeconomic status and maintains the community's altar house, or family shrine. Such chiefly, or dominant, households are also apparent at Copán, suggesting that most people in these clusters were interrelated by marriage or blood (W. Fash 2001).

Unlike modern *sian otots,* several of Copán's clusters have paired sites. The common assumption is that these sites represent two dominant households that were occupied by lineage heads of competing and collaborating extended families (W. Fash 1983a, 1983b; Leventhal 1981). Interestingly, such architectural pairings are much more evident in the east part of the valley—a region with a long, continuous occupation extending back to the Middle Preclassic (ca. 800 BC). In contrast, archaeological data for the far west part of the valley indicate only sparse settlement in the Middle Preclassic, followed by a hiatus, with reoccupation occurring only some 900 years later in the Late Classic (ca. AD 600). Fash (1983a) believes that this settlement pattern arose because the majority of settlements found in the outlying areas of the valley did not appear until the Late Classic, when population rose dramatically. He hypothesizes that the larger, more complex architectural groups (types 3 and 4) located outside the urban core may have been occupied by families who were clients of the state, or were under direct control of the urban elite. Fash posits that their purpose was to inhabit previously "sparsely-cultivated" and "little-occupied" areas of the valley (W. Fash 1983a:272). Why they may have been required to do so remains unclear, but perhaps the population boom of the Late Classic placed greater stress on food resources, necessitating the acquisition of additional agricultural lands.

In addition to the paired site phenomenon, there are other three differences between Copán's settlements and those of the modern Chorti Maya. First, modern *sian otots* spread across two or three miles, whereas Copán's *sian otots* encompass only about one square kilometer (Maca 2009). Second, as AnnCorinne Freter (2004:97) writes:

> Two clear limitations of the *sian otot* model…are the colonialism experienced by the Chorti and the fact that the Chorti did not have a politically dominant noble class or a dynastic ruler. Thus, while aspects of the household organization in the *sian otot* model are enlightening, the model based on Wisdom's descriptions alone contains significant limitations.

She argues, however, that despite these limitations, the *sian otot* model is still useful for understanding sociopolitical organization at Late Classic Copán. Thus, although Fash's (1983a, 1983b) original *sian otot* model may be somewhat simplistic (a fact he himself notes), its basic premise that there were many layers of community social networks, or sub-communities, in the valley is quite legitimate, and provides a useful scale of analysis to better understand interaction between people living in different areas of Copán.

The next section provides a brief description of Copán's twenty-one *sian otots* (as described by Fash), including their location, density, occupation history, demography, and possible socioeconomic function(s), to provide context for the interpretations that are presented in later chapters. Figure 2.9 is a map of the estimated boundaries for the valley's *sian otots*, digitized using descriptions from Fash (1983a) and Leventhal (1979), as well as from the GIS data.

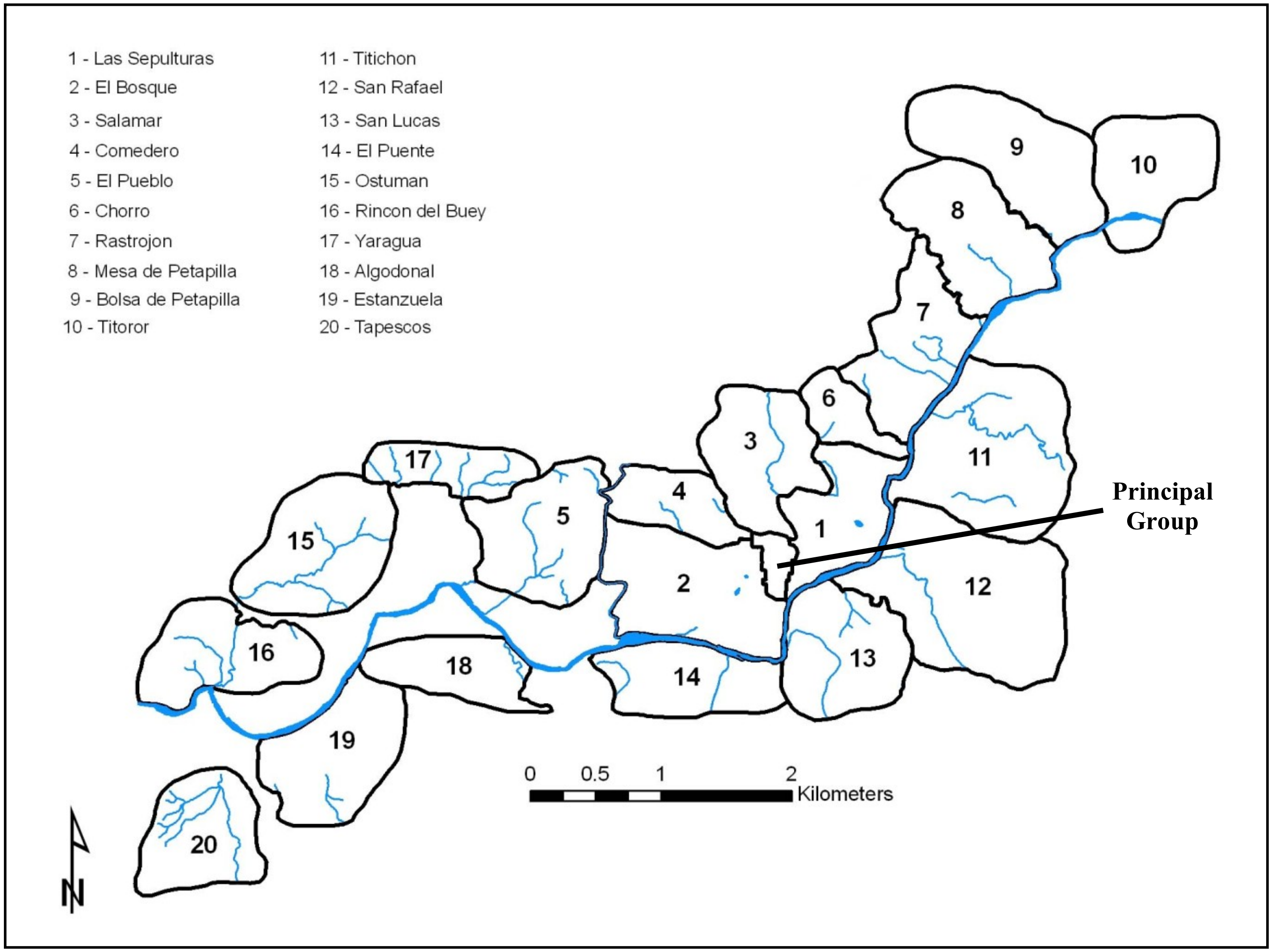


Figure 2.9: **GIS map of Copán's twenty-one *sian otots* including the Principal Group (Richards-Rissetto 2008)**

Las Sepulturas

Las Sepulturas abuts the east side of the city's main civic-ceremonial complex, the Principal Group (see Appendix A Map A.1). Test pits and excavation materials indicate that many of the courtyard groups in this area had long, continuous occupations (e.g., Groups 9N-8, 9M-22, and 9M-24) (Hendon 1987; Webster 1989; Willey et al. 1978), making it by far the most densely settled area in the city by the end of the Late Classic (Table 2.2). The area also contained a diverse population, with elites and commoners living side-by-side but playing distinct roles in the city's political and economic arenas. Many of the elite living in this sub-community are believed to have been part of the royal court, serving as priests, scribes, and possibly even craft specialists. Others are believed to have been absentee landlords owning agricultural lands outside the urban core (Webster 2005). The commoners, most likely lesser kin, servants, or slaves, probably carried out domestic duties for the elite, including cooking, and cleaning, and possibly producing utilitarian wares (Hendon 1987, 1991).

Many of the area's residents were aligned along the site's eastern *sacbe*, some even had small, private *sacbe*, serving to highlight their elite status and move pedestrians toward their homes (Leventhal 1981). In fact, by the end of the Late Classic many of the city's wealthiest residents lived in this *sian otot*, as evidenced not only by the large and elaborate courtyards (Table 2.3), but by major construction projects. These projects include not only the *sacbe*, but also the construction of Structure 10M-1, a large pyramid, erected near the east entrance of the Great Plaza (Figure 2.10). Another project involved the diversion or canalization of the Quebrada Salamar, running along the north side of the *sian otot*, at some point in Late Classic period (Fash 1983a).

Table 2.2: ***GIS-derived settlement density of Copán's*** **sian otots**

Sian Otot	**Area (m^2)**	**No. of Structures**	**Settlement Density (km^2)**	**Rank**
Las Sepulturas	0.66	453	686.36	**1**
Salamar	0.78	301	385.90	**2**
El Bosque	1.07	370	345.79	**3**
Chorro	0.29	97	334.48	**4**
Rastrojon	0.82	263	320.73	**5**
Comedero	0.43	118	274.42	**6**
San Lucas	0.84	190	226.19	**7**
Mesa de Petapilla	0.94	169	179.79	**8**
Ostuman	0.99	150	151.52	**9**
San Rafael	1.59	240	150.94	**10**
Estanzuela	0.88	107	121.59	**11**
Tapescos	0.73	85	116.44	**12**
Yaragua	0.43	43	100.00	**13**
Algodonal	0.55	53	96.36	**14**
Bolsa de Petapilla	1.04	93	89.42	**15**
Titichon	1.39	118	84.89	**16**
Rincon del Buey	0.79	65	82.28	**17**
Titoror	0.76	48	63.16	**18**
El Pueblo	0.91	48	52.75	**19**
El Puente	0.68	35	51.47	**20**
Principal Group	N/A	N/A	N/A	

Moreover, according to Shannon Plank (2003, 2004), the city's final dynastic ruler commissioned several three-part buildings (replicating the layout of Temple 22, built by one of his predecessors, Ruler 13), several of which (Structures 9M-146, 9N-82, 8N-66, 9M-194B, and 9M-195B) were built in this area as part of a major urban renewal project. Las Sepulturas' diverse and dense population, along with the large-scale investment of labor and resources in renewing the area, indicates that the residents of this sub-community played very important roles at ancient Copán, both in earlier times and at the end of the Late Classic.

Table 2.3: ***Counts of site types per* sian otot *at Copán, Honduras***

Sian Otot	**Type 1**	**Type 2**	**Type 3**	**Type 4**
Las Sepulturas	27	14	8	4
El Bosque	56	23	4	5
Salamar	33	16	4	3
Comedero	10	10	0	1
El Pueblo	9	2	0	2
Chorro	11	6	1	0
Rastrojon	44	7	1	0
Mesa de Petapilla	31	9	2	0
Bolsa de Petapilla	15	2	0	0
Titoror	7	0	0	0
Titichon	29	5	0	0
San Lucas	18	4	0	0
San Rafael	41	3	0	0
El Puente	9	1	0	0
Ostuman	21	2	2	1
Rincon del Buey	12	2	0	0
Yaragua	10	1	0	0
Algodonal	15	0	1	0
Estanzuela	20	4	1	0
Tapescos	16	0	0	0
Principal Group	N/A	N/A	N/A	N/A

El Bosque

El Bosque borders the city's main civic-ceremonial complex, the Principal Group, to the west and south (see Appendix A Map A.2). Archaeological materials indicate a long occupation history for this sub-community. Like Las Sepulturas, the area contained a diverse and densely settled population of elites and commoners with roles similar to those played by the inhabitants of Las Sepulturas. The city's western *sacbe* forms the northern boundary of El Bosque. This *sacbe* quite possibly contains a large pyramid (10K-29) that mirroring the one built along the eastern *sacbe*, creating a "cross" pattern with the Great Plaza, which the ancient Maya may have traversed during ritual pilgrimages (Baudez 1991; Newsome 2001; Reese-Taylor 2001).

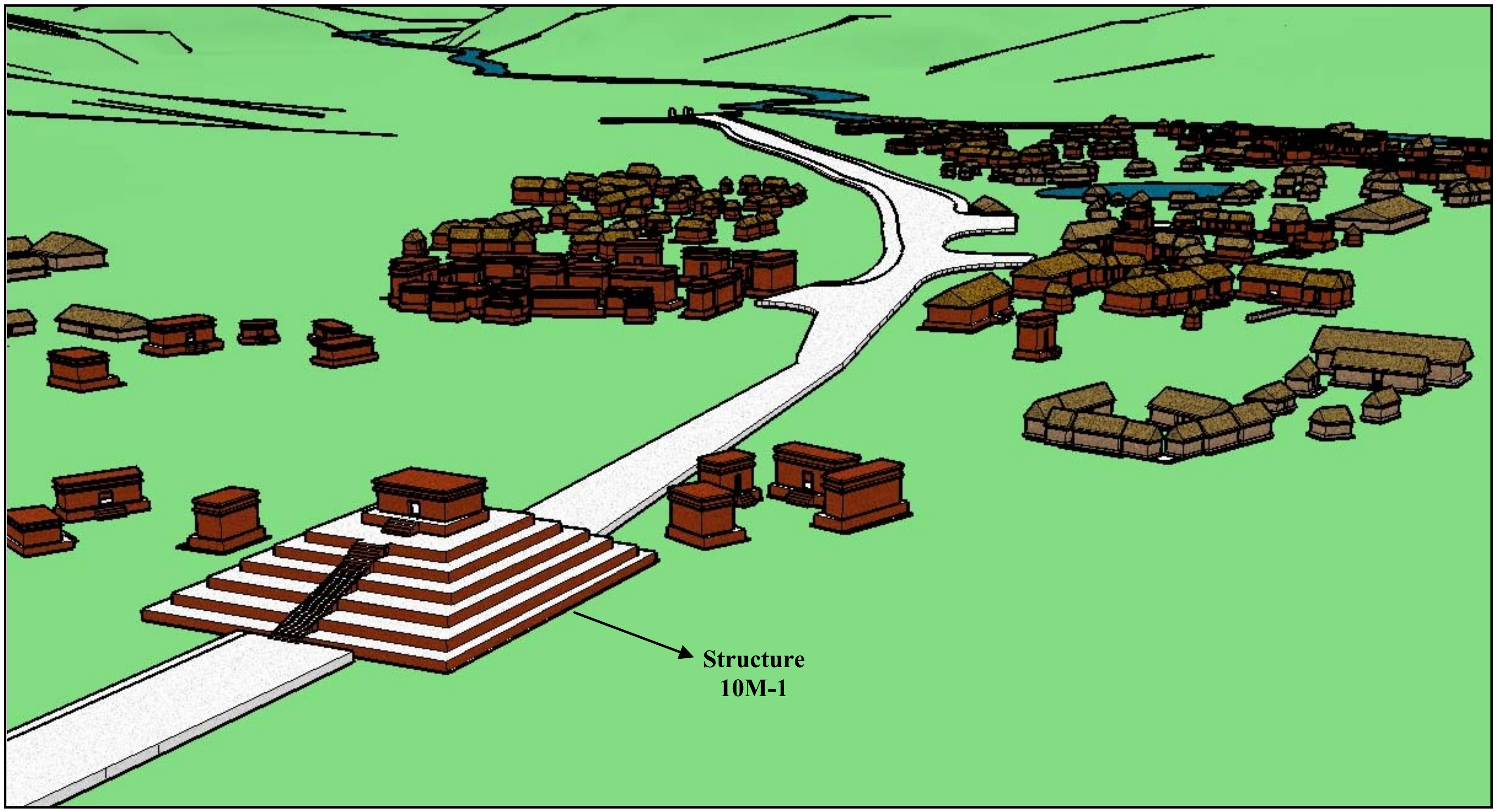


Figure 2.10: **SketchUp reconstruction of Structure 10M-1 at entrance of Las Sepulturas, Copán (Richards-Rissetto 2008)**

The area also contains the only known ball court built outside of Ball Court B in the Principal Group. Furthermore, geomorphological data indicate that the area is recovered swampland, the labor and resource investment required for its requisition reflecting a desire or mandate to live in close proximity to the city's center and its royal court (Hall and Viel 2004; Turner et al. 1983).

The U-Group 11K-6, believed to be one of the four cornerstones of the urban core, is near the edge of this sub-community (Maca 2002). Its placement here highlights the relative importance of this area. In sum, the residents of this *sian otot* appear to have been major players in Copaneco society.

Salamar

The sub-community of Salamar is part of the urban core and was the second most densely populated *sian otot* in the valley with 385.90 persons/km^2. It is delineated by the Quebrada Chorro to the east and a smaller *quebrada* to the west, the mountains to the north, and the Principal Group to the south (see Appendix A Map A.3). The area contains four type 3 sites and two type 4 sites. Three of these sites have been excavated: Groups 8L-10 (type 3), 8L-12 (type 4), and 9L-23 (type 4).

Although details of the excavation of Group 9L-23 have yet to be published, available information indicates that the group exudes wealth, appears to have a long occupation history, and has produced over 120 burials (Seiichi Nakamura, personal communication 2006). Excavation of Groups 8L-10 and 8L-12 has provided insight into ancient Maya cosmology and the Maya propensity for replication (Ashmore 1991).

Groups 8L-10 and 8L-12 are believed to have been built entirely during *Yax Pasaj's* reign, which began in AD 763. Both appear to have been domestic sites, but

Group 8L-10 seems to have sponsored more ritually oriented activities (Ashmore 1991), as suggested by the group's sculpture and iconography, its architecture, and its spatial organization. Group 8L-12 has portrait sculpture with personal references to an individual; Group 8L-10 exhibits more generalized and thematic symbols. The buildings of Group 8L-12 are taller and occupy a smaller, more enclosed courtyard than 8L-10, "the visual effect being one of enclosed or private space in 8L-12 and open or public space in its northern neighbor" (Ashmore 1991:215). Finally, the numerous small, ancillary structures surrounding Group 8L-12 suggest the presence of kitchens, storehouses, and servant residences, all indicative of a more residential function. Given these data, Ashmore believes that these two groups replicate the Principal Group. The open, more public space of Group 8L-10 to the north emulates the Great Plaza, and Group 8L-12 to the south imitates the taller buildings and more enclosed, private spaces of the Acropolis (see Chapter 3). She believes that these groups served as "microcosms celebrating dynastic power" (Ashmore 1991:216), and given that they were erected during *Yax Pasaj's* reign, they may prove another line of evidence supporting Maca's (2002) and Plank's (2004) assertion that Ruler 16 undertook some sort of urban renewal project at the end of the Late Classic. Such findings may suggest that the residents of this sub-community played an integral part in the socioeconomics of the city.

Comedero

Like the other urban core *sian otots*, Comedero has a very long history of occupation going back to the Middle Preclassic period. However, in contrast to its urban neighbors, this sub-community was less densely populated with 274.42 persons/km^2. Moreover, it has only one designated elite site, Group 9J-5. All other sites are classified as commoner households. Sites in this area sit in the northern foothills and tend to have expansive views of the valley to the south, east, and west. The region is crossed by two *quebradas*, Quebrada Comedero and Quebradita Chino, providing the area with ample water (see Appendix A Map A.4).

The location of Group 9J-5 near the terminus of the western *sacbe* and its U shape lead Maca (2002) to identify it as another of the four cornerstone sites believed to delimit the city's urban boundary. It is a large, and complex site (type 4) comprising numerous buildings and several plazas that occupy an elevated position in the landscape. Ceramics from the site date its beginnings to the Early Classic (AD 400−600) with termination rituals taking place sometime during *Yax Pasaj's* reign (AD 763−820) at the end of the Late Classic (Maca 2002). A later midden dating to AD 820−900 indicates that the site was reoccupied sometime in the Postclassic period. Throughout its occupational history, evidence for residential and ceremonial activities abounds. It appears that Group 9J-5 was the focal point of the Comedero *sian otot*, boasting the sub-community's most dominant household. Its owner appears to have been the only elite in the neighborhood, surrounded by lesser kin, servants, and other commoners.

El Pueblo

The modern town of Copán Ruinas lies atop the ancient sub-community of El Pueblo. Consequently, many of the sites in this area have been destroyed; however, maps and notes from early twentieth century researchers provide some information (e.g., Maudslay and Maudslay 1992; Morley 1920). Figure 2.11 shows the locations of several stelae, altars, and monumental buildings in the center of Copán Ruinas that are no longer extant but were still visible less than 100 years ago. The area's occupational history dates back to the Middle Preclassic, and archaeological evidence suggests that it was once the region's religious and administrative center; however, its influence waned at some point in the Early Classic, and a shift of power to the Principal Group occurred, suggesting the presence of a new and powerful lineage (Morley 1920).

During the Late Classic the region appears to have been sparsely settled; however, it is difficult to say whether this lack of archaeological remains is due to the modern construction or represents an ancient settlement pattern. The *sian otot* has two elite sites (both type 4) located about 400 meters apart, both along the regions' eastern boundary in fairly close proximity to the city's western *sacbe*, but separated by the fast-flowing Quebrada Sesesmil (which drains into the Río Copán). The area has 10 known commoner sites (types 1 and 2), which are believed to have housed lesser kin living near their lineage heads, who occupied the area's two dominant households (see Appendix A Map A.5). Given its location in the northern foothills overlooking fertile lands along the river, the occupants of El Pueblo may have been farmers producing food not only for themselves, but also for some of the city's more urban residents.

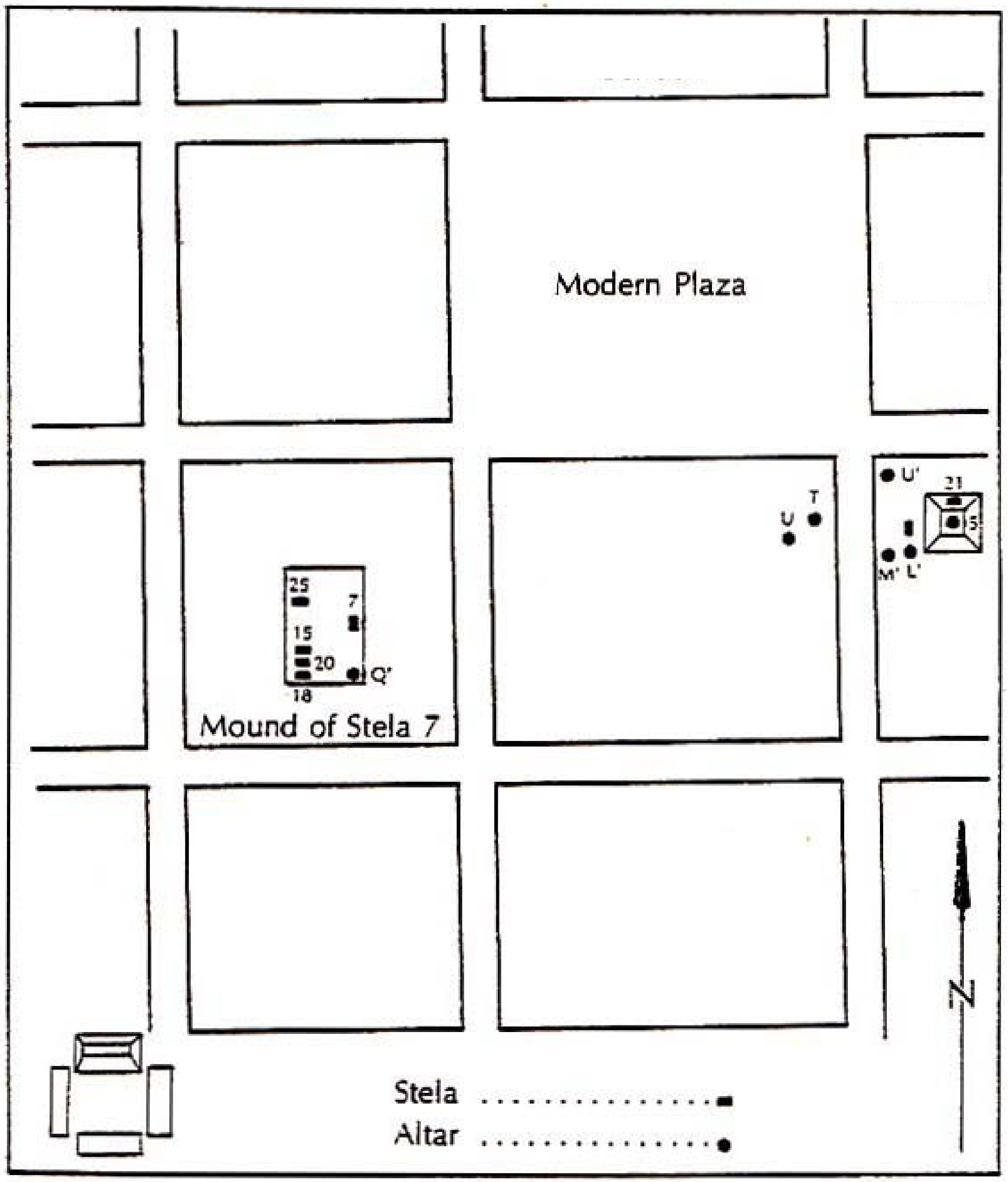


Figure 2.11: **Map of stelae, altars, and monumental structures in center of Copán Ruinas (modified from Morley 1920)**

Chorro

The sub-community of Chorro is circumscribed by the Quebrada Chorro to the west and south, the Quebrada Lobraje to the northeast, the mountains to the north, and the Río Copán to the east (see Appendix A Map A.6). The area is marked by a small hill rising sharply out of the bottomlands. Interestingly, no ruins have been discovered atop this hill. Like its neighbors, the area has a long history of continuous occupation dating back, in some parts, to the Preclassic (Leventhal 1979). Although historically the area has been used for milpa farming, the presence of limestone and green tuff outcrops within and close to the region suggests that prehistorically its residents may have performed a variety of socioeconomic functions. Some residents may have been farmers, some may have worked at the local quarries, and others may have served as domestic servants for the elite living at the sub-community's two elite households (W. Fash 1983a).

The *sian otot* was densely settled with 334.48 persons/km^2, and consisted of one dominant household (Group 7M-16) and several commoner groups (types 1 and 2). It is also the location of Group 7M-8, another of Maca's (2002) U-Groups, which is believed to mark the northern boundary of the urban core. By the end of the Late Classic, as Copán's population boomed and seemingly became more diversified, the area's residents represented a variety of social roles, including urban elite, rural landlord, domestic servant, quarryman, and even craft specialist (W. Fash 1983a).

Rastrojon

Rastrojon shares many characteristics with its southern neighbor, Chorro. It is also circumscribed by two quebradas, the northern mountains, and the Río Copán, and contains outcrops of limestone and green tuff (see Appendix A Map A.7). It has a long history of occupation, with residents who appear to have been milpa farmers and possibly quarrymen (W. Fash 1983a). However, unlike its southern neighbor, the sub-community's population was spread out over a much larger area. A quebrada divides Rastrojon into a northern and a southern section. The northern section consists of small, relatively dispersed type 1 and 2 sites, suggesting that its residents were less wealthy and less important than those to the south (Leventhal 1979). The southern section has one dominant site (Group 7M-4) and was more densely populated. In sum, inhabitants living in the south half appear to have had more in common with their neighbors in Salamar and Las Sepulturas than with residents in their own sub-community. It may be that residents living in this area were being affected by urban encroachment by the end of the Late Classic, while those in the northern section were not yet impacted by this expansion. Another possible explanation is that individuals living in Rastrojon were actually members of two distinct sub-communities, not a single sub-community as the *sian otot* model posits.

Mesa de Petapilla and Bolsa de Petapilla

Like their Zone 3 southern neighbors, there is evidence that parts of Mesa de Petapilla and Bolsa de Petapilla were inhabited almost continuously from the Preclassic to the Late Classic (W. Fash1983a). Present-day use centers on farming, and archaeologists believe that the areas' ancient residents were also small-scale farmers. The two sub-communities share similar environmental characteristics, yet have basically different settlement patterns (see Appendix A Maps A.8 and A.9). Mesa de Petapilla, the more southerly of the two, had a settlement density twice that of Bolsa de Petapilla. Moreover, Mesa de Petapilla has two elite sites, while Bolsa de Petapilla has none. In fact, most of Bolsa de Petapilla's sites are small type 1 sites, while Mesa de Petapilla has several somewhat larger type 2 sites. Although residents of both areas are believed to have been engaged in farming, the differences in their settlement patterns suggest that they may have played somewhat different sociopolitical roles in Copán's society as a whole. Mesa de Petapilla's elite may have overseen agricultural production of lands to the northeast. If this is the case, then perhaps the Bolsa de Petapilla *sian otot* is in reality a part of Mesa de Petapilla, suggesting that cultural criteria (i.e., architecture) take precedence over environmental criteria (i.e., *quebradas*) in delimiting the city's ancient sub-communities.

Titoror

Titoror is located at the east entrance of the Copán Valley (see Appendix A Map A.10). It is home to Stela 13, which is believed to have been erected by Ruler 12 to mark the eastern boundary of Copán (W. Fash 1983a, 2001). The area was very sparsely populated, with 63.16 persons/km^2 and only a few scattered type 1 sites. The residents of this area were most likely farmers and probably had some relationship with Stela 13, but the location of the stela about 75 meters away from any sites suggests that any role the in inhabitants may have played in relation to the monument was tangential to their daily lives. Living in the outskirts almost 4 kilometers from the city's center in relatively small and inexpensive homes, Titoror's residents most likely lived their daily lives in relative autonomy and anonymity.

Titichon

Titichon is on the south side of the Río Copán in an area characterized by moderate to steep slopes with flat land along the *quebradas* (see Appendix A Map A.11).

Today the area is used primarily for milpa farming; however, there is evidence of modern (and quite possibly ancient) terracing, suggesting that by the end of the Late Classic some members of this sub-community were practicing intensive agriculture (W. Fash 1983a). Like the sub-community of Bolsa de Petapilla to the north, parts of this area appear to have been continuously occupied back to the Preclassic.

The sub-community was somewhat sparsely populated, with pockets of settlement located along the area's three major *quebradas*. According to the Harvard Typology, the area contains no elite sites, but there is one group for which the archaeological evidence suggests otherwise. Group 9P-5, paired with Group 9P-1 in the southeast corner of Titichon, is designated as a type 2 site because it comprises fewer than eight mounds, all of which are less than 3 meters high. However, test pits revealed a relatively large number of Copador and Babilonia (Lenca) polychromes (luxury goods) in association with one of the site's stone platforms. Moreover, the "imposing" nature of the group's architecture, along with its dressed tuff blocks, indicates that the occupants had a relatively high social standing (W. Fash 1983a:125). These data suggest that the inhabitants of 9P-5 were of elite status, and given the relative absence of nearby sites, they may have been landlords overseeing some of the region's agricultural production. Titichon's other type 2 sites are also surrounded by land rather than sites, suggesting that its residents were made up of elite landlords and rural farmers, who provided food not only for themselves but quite possibly for the city's more urban members. (Test pits or excavations are required to determine if these other type 2 sites also have elite materials, e.g., polychrome pottery and dressed stone.) These data suggest that economic status (as designated by the Harvard Typology) does not directly translate into social status, and therefore additional criteria (e.g., emic, location-specific) may need to be incorporated into the typology.

San Lucas, San Rafael, and El Puente

These three *sian otots* are ecologically diverse, consisting of bottomlands, high river terraces, and foothills (see Appendix A Maps A.12, A.13, and A.14). A series of stone terraces on some of the hillsides presumably were constructed to prevent erosion, facilitate soil buildup, and most likely as prehistoric agricultural terracing (W. Fash 1983a). Surprisingly, both San Lucas and San Rafael were relatively densely populated. In contrast, El Puente had the lowest population density in the valley. Despite these differences in population density, all three sub-communities have similar settlement patterns. None of them are designated as elite; however, like their northern neighbors living in Titichon, they have several type 2 sites that seemingly overlook surrounding agricultural lands. In reality, elites may have lived at these sites, but because they played a different role than some of the valley's other elite, the composition and organization of their households was somewhat different. The region's other residents are believed to have been commoners who supported the area's agricultural production.

Ostuman

Ostuman is in an intramountain pocket, drained by the Quebrada El Chucte, and its bottomlands contain the most productive agricultural lands, in the western part of the valley (see Appendix A Map A.15). The settlement density was somewhat higher than in neighboring *sian otots,* and it contains the most elaborate and complex site in the west half of the valley, Group 10E-6 (type 4). The site is centrally located within the sub-community, about 200 meters from a permanent spring. It consists of 13 mounds oriented along a northwest-southeast axis, has two plazas, and appears to have a pyramid-shaped structure (Str. 10E-34). Ceramics recovered from survey and test pits reveal Middle Preclassic and Late Classic occupations with no evidence of habitation during other time periods (W. Fash 1983a); however, more recent excavations at the site suggest that there was an Early Classic component (Landau 2009).

Ostuman contains two other type 3 elite sites, Group 10F-1 and Group 11E-2, both relatively isolated and believed to have been surrounded by agricultural lands. Group 10F-1 about 340 meters northeast of Group 10E-6, consists of 12 mounds and three plazas. All ceramics recovered from test excavations were from the Late Classic period, and there is no evidence for any earlier occupations. The presence of relatively high quality polychrome sherds indicates its occupants were most likely of elite status (W. Fash 1983a). Group 11E-2 about 140 meters south of Group 10E-6 and contains 18 mounds and at least 3 plazas.

In general, occupation in the western part of the Copán Valley appears to have been relatively short-lived, much of it limited to the Late Classic period, with Group 10E-6 seemingly an exception. This longevity may be the reason that the residents of this group appear to have been the wealthiest in the region. Their prosperity seems to have spread to some of their neighbors, who were also relatively wealthy. The wealthier citizens most likely were landowners or landlords overseeing nearby farming endeavors in some of the valley's richest agricultural lands.

Rincon del Buey and Yaragua

Residents of these two *sian otots* seem to have been of the same socioeconomic group, that is, farmers, as those living in Ostuman, but exhibiting less overall wealth.

Much of the land adjacent to the Río Copán was apparently uninhabited, reserved for agricultural needs (see Appendix A Maps A.16 and A.17). Neither community has any sites designated as elite (type 3 or 4); however, each has one or two type 2 sites that stand out from the type 1 sites because they are larger in size, more elaborate, stand on higher platforms, and are fewer in number. Because these type 2 sites were distinctly different from their neighbors, I argue that their occupants may actually have been lesser elites living at households that played a dominant or leading role in sub-community dynamics. In sum, these ancient sub-communities were predominantly focused on agriculture, and the area's large uninhabited tracts of land suggest that its residents may have supplied much of the valley's food (W. Fash 1983a).

Algodonal, Estanzuela, and Tapescos

These three *sian otots* are on the high river terraces and foothills south of the Río Copán in the western part of the valley (see Appendix A Map A.18, A.19, and A.20). Like their northern neighbors, these sub-communities are believed to have been primarily agricultural, because the land was not densely occupied and sites were surrounded by open terrain (Leventhal 1979). The sub-communities of Algodonal and Estanzuela each have a single type 3 elite site, whereas Tapescos has no elite sites. Interestingly, the region contains only four type 2 sites, all of which are clustered together near the midpoint between Algodonal and Estanzuela. More sites in this area are classified as type 1 groups belonging to Copán's poorest residents. The question is whether these people were small independent farmers or worked for elite landowners. However, the presence of large segments of unoccupied lands overseen by a large elite household is the same settlement pattern identified in other regions of the valley, suggesting elite control over food production (Leventhal 1979).

All ceramics recovered from test excavations in these *sian otots* were from the Late Classic period. These data, together with the ceramic data from Rincon del Buey, Ostuman, and Yaragua, suggest a shorter occupation sequence in the western half of the valley than in the eastern half. In fact, the only exceptions appear to be two large elite groups (Ostuman's Group 10E-6 and Estanzuela's 14F-1) in which archaeologists recovered a few ceramics dating to earlier time periods (Baudez 1983). (Some Early Classic ceramics were uncovered in the Late Classic fill of Group 14F-1, and some Middle Preclassic ceramics were found in test pits of Group 10E-6.) In both cases, it is believed that these large, complex elite households may owe some of their elaborateness to their longevity. That is, their longer occupation history allowed them to acquire more wealth and resources (most likely as land) than the more recent occupants of the region (whether they were lesser kin or immigrants). In sum, the majority of these sub-communities' residents were relatively poor farmers, possibly landless, who "arrived" in the region quite late in Copán's history (W. Fash 1983a).

Summary of Copán's Sub-Communities

In 1979, Richard Leventhal identified nineteen sub-communities in the Copán Valley. The criteria he used to establish these sub-communities included ecological and settlement pattern data. He argued that the valley's sites were organized into clusters that were separated by *quebradas*. Building upon this scholarship, William Fash (1983a, 1983b) refined Leventhal's organizational scheme. Using contemporary Maya *sian otots* as an analogy for ancient Copaneco society, he identified twenty sub-communities (excluding the Principal Group) within the valley's mapped 24-square kilometer area. Modern Chorti settlements typically house 14 to 36 architectural groups (Wisdom 1940). Figure 2.12 shows that settlement size in half of Copán's *sian otots* is comparable to Chorti communities, while the other half fall outside the norm. Four *sian otots* are smaller than expected (Yaragua, El Puente, Titoror, and El Pueblo); however, in actuality El Pueblo most likely does not fall into this category, as much of the ancient settlement has been destroyed by the modern town. Six *sian otots* are larger than expected (Mesa de Petapilla, San Rafael, Rastrojon, Salamar, Las Sepulturas, and El Bosque).

Not only do Copán's *sian otots* exhibit different settlement sizes, but some *sian otots* appear to be more formally organized than others. Some are loosely clustered, seemingly built in a haphazard manner, while others have formal courtyards. Most of the more formal groups (at least those in the hinterlands) may have had centralized ceremonial structures (Leventhal 1979). Julia Hendon's (1987) research in the urban sub-community of Las Sepulturas suggests that people held ritual ceremonies in many different types of places, not necessarily in specialized religious structures. The differences between Leventhal's and Hendon's findings may reflect different ideological practices in rural and urban contexts, or they may simply be a bias resulting from the larger number of excavations in Las Sepulturas than in the hinterland sub-communities.

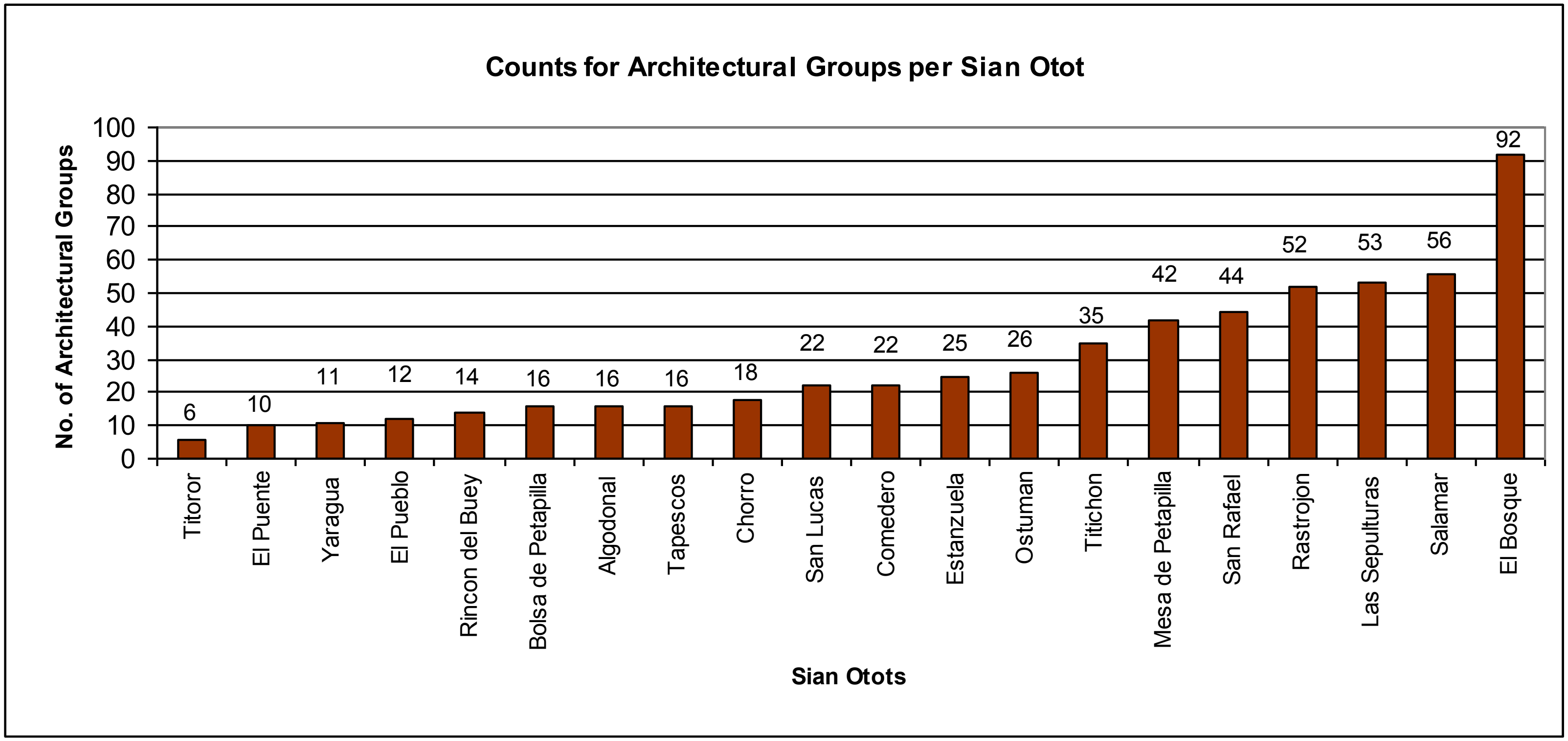


Figure 2.12: **Number of sites per *sian otot* at Copán, Honduras (based on Baudez 1983)**

The differences in the findings of the two studies may also reflect chronological differences between the eastern and western parts of the valley. Test pits and excavations in the east indicate that this part of the valley has a long and continuous occupation dating back to the Middle Preclassic. In contrast, the western half of the valley has a relatively short-lived occupation sequence limited to the Late Classic period, with the exception of a two large sites in Ostuman. Differences between these two areas can also be seen in their dissimilar settlement patterns. In the Late Classic period, residents in the western part of the Copán Valley built their houses on flat land, whereas people living in the east often built their homes on gentle slopes. This difference may be due to increased population pressure and the need to preserve flat plots of land for agricultural purposes in the eastern part of the valley (W. Fash 1983a).

In general, it is believed that occupants of Copán's less formalized sub-communities had a different social status than individuals living in regions with at least one dominant household, because the lineage head living at such a household probably played a centralizing role, bringing people together for social, economic, and religious purposes. For example, Leventhal (1979) argues that the taller, more elaborate buildings found in most of Copán's hinterland *sian otots* are religious structures. Assuming that this is true, then residents of some sub-communities would have had a central place of worship, while others would have been required to travel to another community to participate in communal rituals, placing them in a lower status position (ceremonial dependency) relative to individuals who controlled the place of ritual (Preucel 2001). In the urban areas, people may have worshiped both at the household level and within the site's main ceremonial complex, the Principal Group. (This is not to say that individuals living in the countryside did not periodically attend ritual events in the Principal Group, but rather that those living in the urban core most likely worshiped there with greater frequency.)

Despite the likely existence of centralized places of worship within most of Copán's sub-communities, archaeologists do not believe that these areas were "minor ceremonial centers" or "secondary regional centers" (Leventhal 1981). That is, they were not autonomous regions; instead, they were 'managed' by elite families who controlled the surrounding lands, but who ultimately answered to the king. It is in these sub-communities that ancient Copanecos spent much of their time. It is in these places that their daily routines took shape, forming their experiences, influencing with whom they interacted, and fulfilling most of their social and religious needs. In sum, residents of some *sian otots* had greater access to the city's major civic-ceremonial resources, the royal court, and more diverse neighbors (i.e., individuals outside their extended family), while others had greater access to the valley's agricultural lands, quarries, and other natural resources.

Harvard Site Typology: Site Types 1-5

Although residents of the same *sian otot* had many shared experiences, they were not homogeneous. Some lived in large homes and performed managerial tasks such as overseeing agricultural lands, some served as religious, administrative, or craft specialists, others were domestic servants who cooked, cleaned, tended to kitchen gardens, or carried out other household duties, and still others lived in small homes and worked in the fields growing maize, squash, and beans for their families and for the elite.

The roles that individuals played in society influenced their wealth and status, which in turn affected their ability to procure resources, both labor and goods. Archaeologists who believe that these socioeconomic differences are reflected in the site's architecture created the Harvard Typology.

The typology organizes Copán's architectural groups into five formalized types (site types 1−5) and two ancillary types (small isolated platforms and small platform clusters) based on size and complexity (w. Fash 1983a; Leventhal 1979, 1981; Willey et al. 1978). Individual structures were assigned to particular architectural groups or sites, using a nearest-neighbor method in which buildings within a 10-meter radius of one another were assigned to the same group (Baudez 1983). While this approach is somewhat arbitrary, no one has identified an alternative method for clustering architectural groups at Copán.

As for the seven-part classification, most of the valley's small, isolated platforms are located in the upper foothills. They are low-lying platforms composed of a single set of roughly shaped stones measuring 2 to 3 meters per side. The function of these structures is unclear; however, they are hypothesized to be field houses or outbuildings (Leventhal 1979). As for the site's small platform clusters, they consist of small platforms without an apparent central plaza and are typically linearly arranged along the small natural terraces of the foothills. Their function is also uncertain.

Copán's more formalized types are categorized according to size, complexity, mound height, and construction materials (Willey and Leventhal 1979; Willey et al. 1978). Type 1 sites comprise three to five mounds and represent a single household (Figures 2.13 and 2.14). Type 2 sites have six to eight mounds and represent two households (Figures 2.15 and 2.16). Type 3 sites also are made up of six to eight larger mounds and are believed to represent three households (Figures 2.17 and 2.18). Type 4 sites are complex groupings with multiple plazas that support four or more households (Figures 2.19 and 2.20). They are typically located on the low river terrace and frequently have several construction stages suggesting lengthy and complex occupational histories. There is only one type 5 site at Copán, the site's main civic-ceremonial center, or the Principal Group (Figure 2.21).

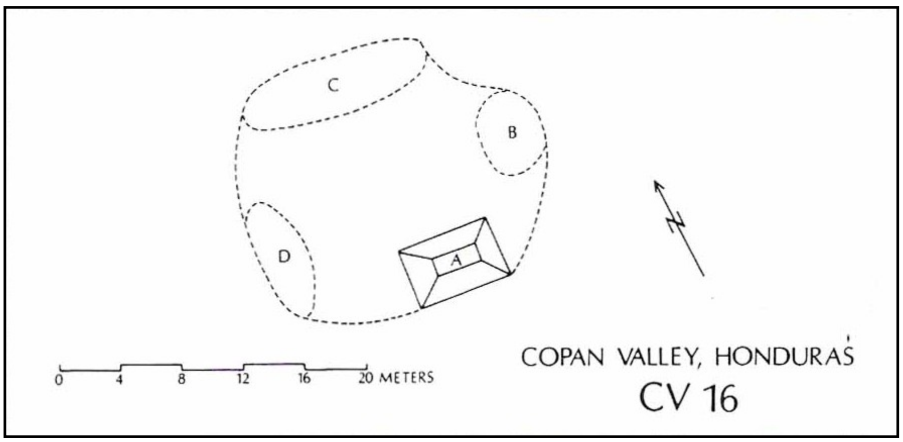


Figure 2.13: **Type 1 site at Copán, based on Harvard Typology (from Willey and Leventhal 1979:82)**

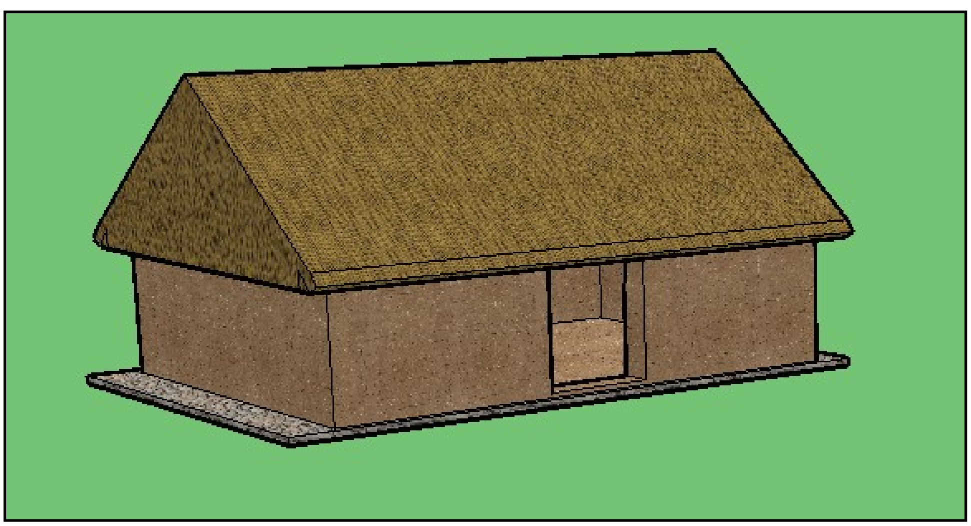


Figure 2.14: **SketchUp reconstruction of type 1 site (Richards-Rissetto 2008)**

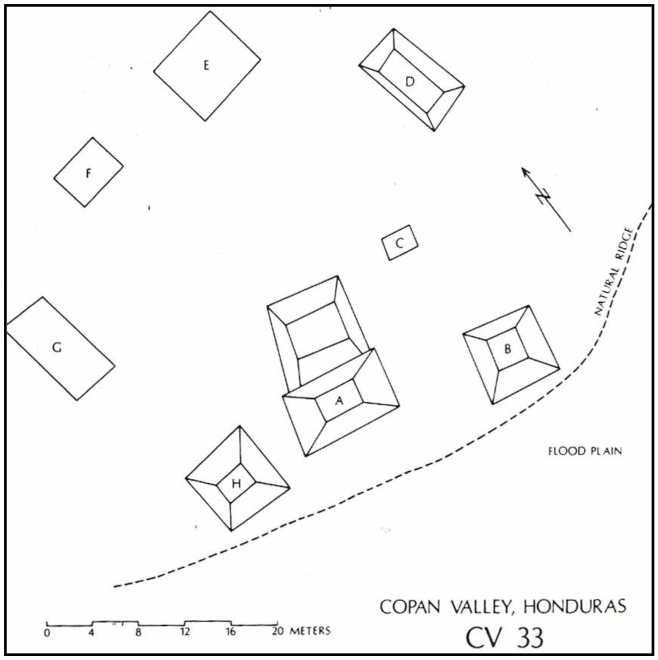


***Figure 2.15:* *T*ype 2 site at Copán, based on Harvard Typology (from Willey and Leventhal 1979:83)**

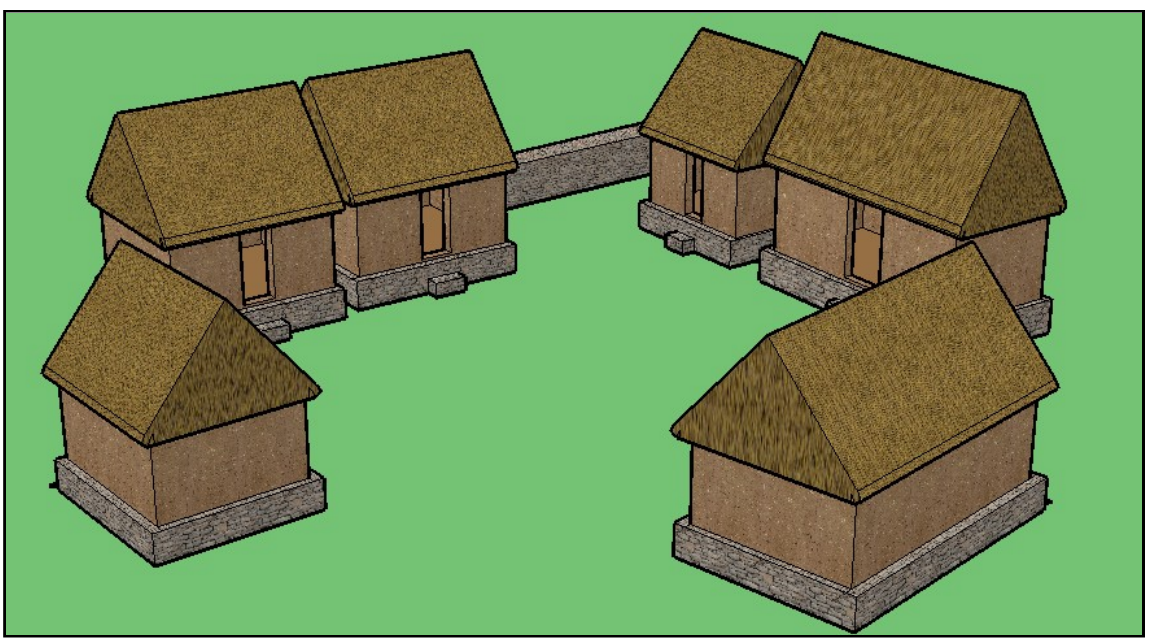


***Figure 2.16:* SketchUp reconstruction of type 2 site (Richards-Rissetto 2008)**

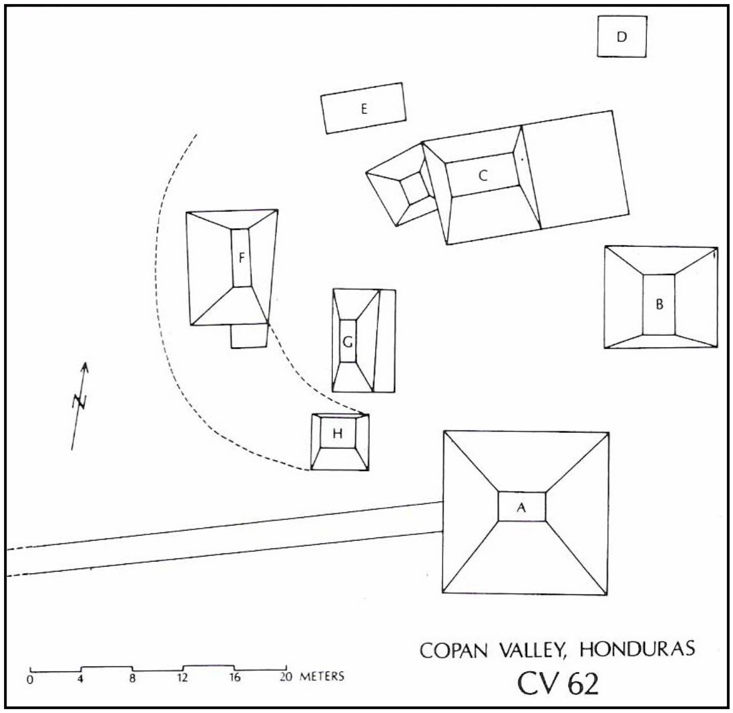


Figure 2.17: **Type 3 site at Copán, based on Harvard Typology (from Willey and Leventhal 1979:84)**

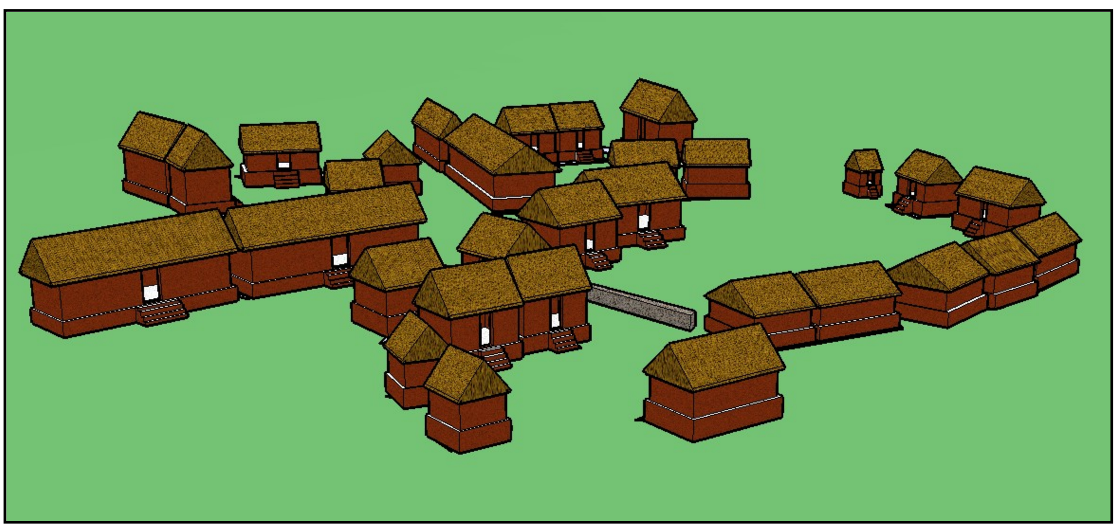


Figure 2.18: **SketchUp reconstruction of type 3 site (Richards-Rissetto 2008)**

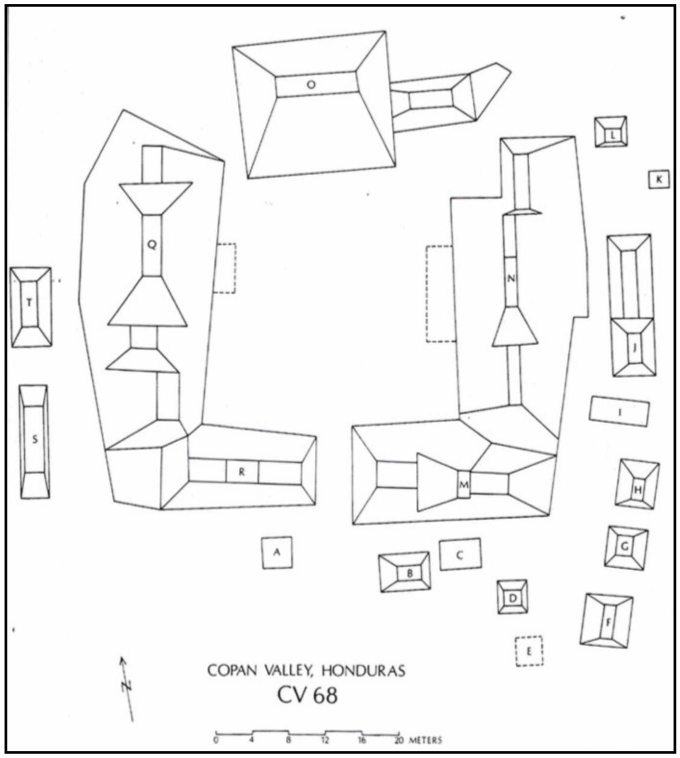


Figure 2.19: **Type 4 site at Copán, based on Harvard Typology (from Willey and Leventhal 1979:85)**

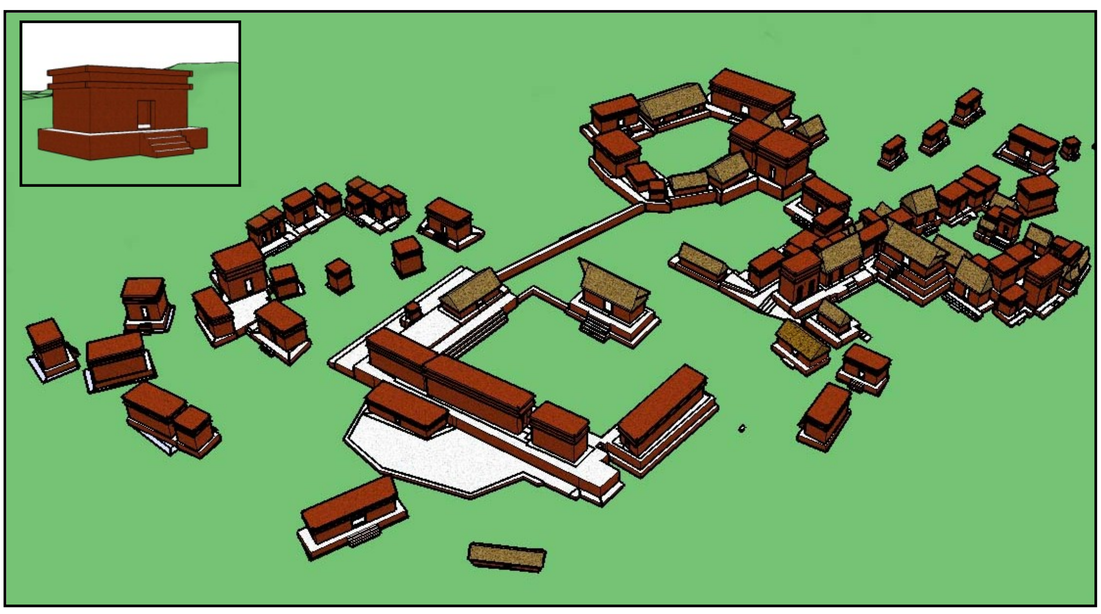


Figure 2.20: **SketchUp reconstruction of type 4 site (Richards-Rissetto 2008)**

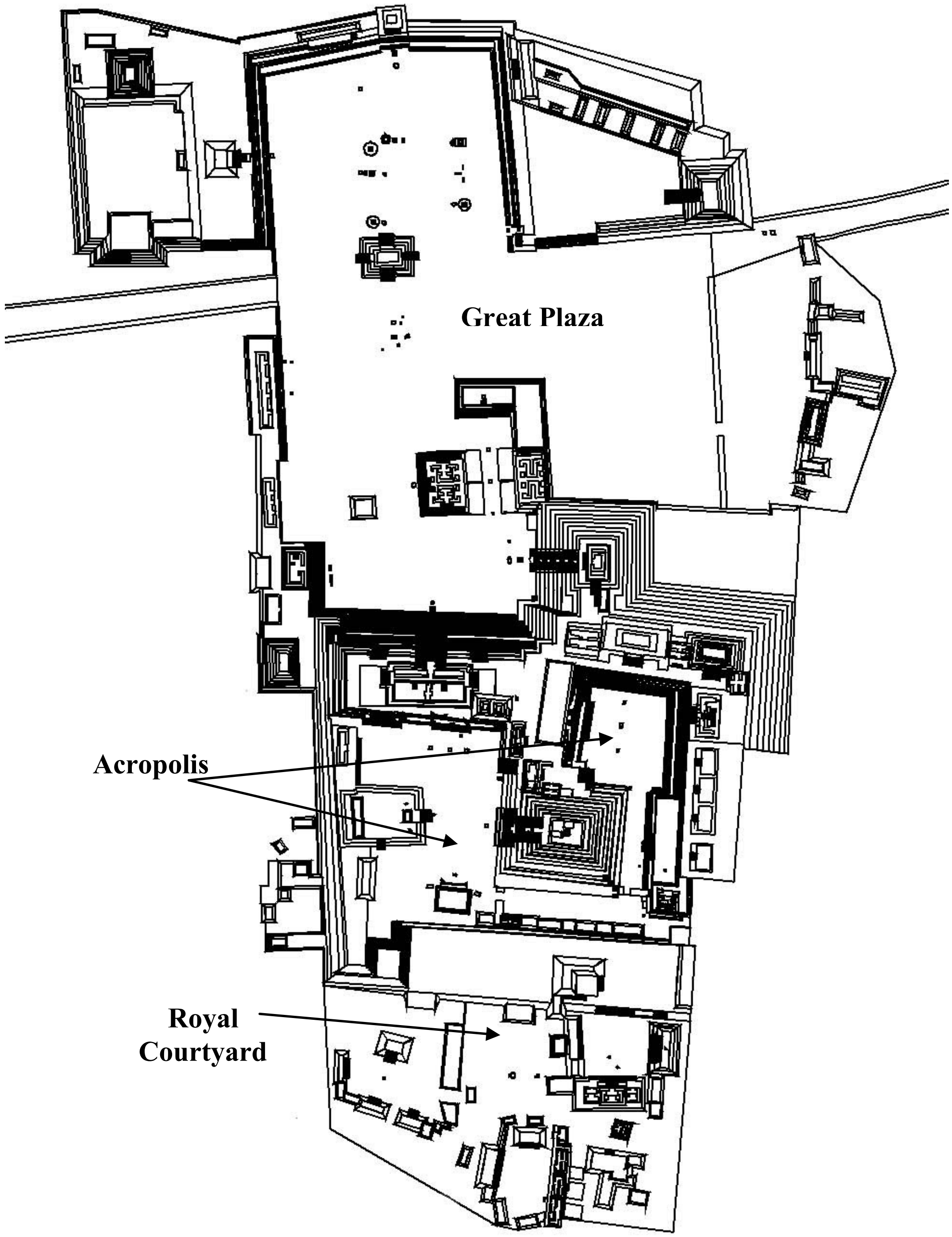


Figure 2.21: **GIS map of type 5 site at Copán**
(compiled from W. Fash and Long 1983 and Hohmann and Vogrin 1982)

The initial settlement surveys from which these five types were created have been followed by almost three decades of testing and more extensive excavations throughout the valley (e.g., Baudez 1983; Davis-Salazar 2003; Freter 1994; Hendon 1987, 1991; Maca 2002; Webster 1989). Floor plans, associated artifacts, caches and other features indicate that types 1−4 functioned primarily as residential groupings of dwellings and associated structures, including kitchens and storage buildings (Laughlin 1969; Leventhal 1979, 1981; Wauchope 1938; Willey 1997; Willey et al. 1978). In general, the settlement data support the hypothesis that these types reflect economic status, with larger structures and more complex groupings reflecting higher status and wealth. In addition, these survey and test unit data provide temporal information indicating that all visible structures date to the Late Classic period (W. Fash 1983a). This means that the city's final configuration is captured in the valley's settlement maps. Consequently, these maps can be used to evaluate whether the spatial layout of Late Classic Copán exhibits a spatial hierarchy that mirrors its social hierarchy.

Furthermore, given that all surface remains seemingly date to the Late Classic, archaeologists have been able to use these data to identify settlement patterns and formulate interpretations about sociopolitical organization during this time. From these data they have deduced that the organization of Copán's architectural groups is somewhat unique in the Maya region. Compared to other well-documented sites, such as Seibal or Tikal (Ashmore 1981; Haviland 1981; Tourtellot 1983, 1988), Copán's architecture exhibits three major differences: (1) smaller individual house platforms, (2) more than a single patio, or courtyard, in many architectural groups and (3) a larger than normal proportion of "informal groups", that is, groups that are not patio groups (W. Fash 1983a:

274-275). The reasons for these differences are unclear, but some archaeologists have suggested that they relate to the nature of social organization at the site. Individual structures appear to have housed nuclear rather than families, leaving the multiple courtyards to accommodate the extended family (Leventhal 1979).

The diversity of archaeological remains, from both Copán and other ancient Maya sites, reflects a wide range of social roles (Collins 2002; Freter 1994; Hendon 1987). Elites and commoners did not form two homogeneous groups; instead, they exhibited a great deal of internal social differentiation (Marcus 1992). The elite included not only the ruler and the royal family, but also major and minor nobility. Commoners were farmers, servants, and craft specialists, who carried out duties ranging from cooking to cleaning to quarrying to producing pots, and stone tools, and much more. Many other positions existed in these ancient cities, such as priests, scribes, specialists in textiles, other artisans, architects, engineers, water managers, landlords, and public works managers; in some cases they may have held elite status, in others they were part of the hoi polloi. Building public works involved not only erecting monumental architecture, but also constructing reservoirs, terracing for agricultural purposes and to stabilize hillside residential sectors to prevent soil erosion (e.g. Group 9J-5), and arroyo canalization (W. Fash 1983a; Leventhal 1979; Maca 2002; Turner et al.1983). All of these groups were embedded in a network of complex social, political, and economic relations.

Conclusions

Explorers and researchers have been working at the ancient Maya city of Copán, Honduras, for over two centuries, making it one of the most extensively studied archaeological sites in Mesoamerica. For most of these years, the focus has been on elite culture, with archaeologists and others studying the site's main civic-ceremonial architecture and elite residences. Using epigraphic, iconographic, architectural, and archaeological data from these areas, researchers have reconstructed Copán's dynastic history. This knowledge has helped scholars to better understand how almost 400 years of dynastic rulership shaped the city and its residents' lives. It is these historical circumstances that provide a broader context for interpreting what we see at the end of the Late Classic during *Yax Pasaj's* reign (AD 763-820). During this time period, Copán's residents simultaneously experienced florescence and "collapse." There were extraordinary achievements in art, architecture, writing, and astronomy, but there was also overpopulation, nutritional stress, and environmental degradation (e.g. Abrams and Rue 1988; W. Fash 2001; W. Fash et al. 2004; Rue 1987; Storey 1992; Webster 2002, 2005; Webster et al. 2000; Whittington 1989; Whittington and Reed 1997). These factors along with the city's historical circumstances, worked together to shape ancient Copaneco society at the end of the Late Classic.

For the past thirty years some researchers have shifted their focus to the more mundane aspects of ancient Copán. Archaeologists began to implement a new research design, one comprising settlement pattern surveys, test pitting, and excavations of non-elite, or commoner, households (e.g., Baudez 1983; Freter 1994; Leventhal 1979). These data (especially those collected via survey and test pits) provide critical chronological information. They show that the surface remains can be directly attributed to the Late Classic, which means that the site's survey maps capture the city's final configuration. They do not represent a palimpsest of Preclassic, Early Classic, and Late Classic structures, which means that observed spatial patterns can be attributed to Late Classic sociopolitical, economic, and ideological processes. This is not to say that earlier practices did not inform later practices (in other words, Late Classic site configuration), quite the contrary, but rather the city's architecture and its configuration provide a footprint of social structure and social interaction and segregation that can be directly linked to the Late Classic.

Archaeologists have also used these settlement data to talk about the valley at five different scales: valley-wide, physiographic zones, urban core−hinterlands, *sian otots* (intra-valley sub-communities), and patio groups (referred to as sites at Copán). The valley-wide perspective includes all sites in a 24-square-kilometer area. The five physiographic zones are classified according to ecological and archaeological data. The urban core and its hinterlands have been delineated in two different ways. Using an etic perspective based on settlement density, early archaeologists defined the urban core as El Bosque, Las Sepulturas, and the Principal Group. In contrast, Allan Maca's (2002) more recent research delineates the urban core's boundaries using an emic perspective based on cosmology and the U-Group architectural configuration. His findings expand the boundaries of the urban core to include not only El Bosque, Las Sepulturas, and the Principal Group, but also Comedero, Salamar, and Chorro.

At Copán, as elsewhere in the Maya region, most intra-site studies focus on either the main civic-ceremonial complexes or individual patio groups. Few ethnographers have researched groupings larger than the extended family (W. Fash 1983a; Roys 1943; Vogt 1969). One notable exception is Charles Wisdom's (1940) study on the Chorti of eastern Guatemala, which provides a model for community organization beyond the extended family. This model is based on the *sian otot*, or aldea ("many houses"). Given that many scholars believe that the ancient Maya of Copán were Chorti speakers (Morley 1920; Thompson 1970; Wisdom 1940), some version of this model seems quite appropriate for studying community organization at ancient Copán. Moreover, modern Chorti's upland environment with its rolling hills and intermittent and perennial streams is very similar to that of the Copán Valley (W. Fash 1983a).

Using both ecological and archaeological data, Leventhal (1979) and later Fash (1983a, 1983b) identified twenty-one such *sian otots* in the Copán valley including the Principal Group. They posited that these sub-communities originated in close proximity to *quebradas* (stream cuts) to satisfy both agricultural and domestic purposes and were made up of extended families with individuals related through either blood or marriage. These *sian otots* provide an ideal scale of analysis to study interaction among potentially distinct communities at Copán, especially given that they are likely to reflect an emic, or indigenous, concept of neighborhood or sub-community grouping (W. Fash 1983a). As Fash writes, investigations into "how such entities were organized, both internally and as parts within the larger socio-political entities" of Copán can provide great insight into the city's Late Classic sociopolitical organization (W. Fash 1983a:271).

Within these sub-communities, a clear division between elite and commoner households has been identified. Archaeologists have used differences in size, complexity, and construction materials and techniques to create the Harvard Typology, which classifies Copán's architecture into five formal site types and two non-formalized site types. Since its introduction in the late 1970s, archaeologists have used excavation data to test whether these site types truly reflect socioeconomic differences (e.g., Hendon

1987; Sanders 1989; Webster and Gonlin 1988). With respect to economic differences, the typology has stood the test of time; however, correlating architecture to social status has proven more difficult. Archaeologists assume that a higher economic status equates to a higher social status. In most cases, this assumption seems appropriate at Copán. However, there are specific cases in which the typology must be reassessed. For example, several of the city's *sian otots* do not have a type 3 or 4 site, which according to the Harvard Typology means that all their residents are commoners. *Does this mean that these sub-communities are devoid of elites? Or is it possible that some of the type 2 sites found in these sian otots actually house elites, who simply have smaller and less complex households than some of the cities wealthier elite?* To address these questions it is necessary to incorporate additional criteria into the Harvard Typology, criteria that move away from a strictly etic perspective to help us better distinguish the social from the economic.

This dissertation approaches this problem by incorporating measures of access (integration) and visibility into the typology and using the resultant data to reconstruct how the city's spatial configuration may have been used to manipulate pedestrian movement and convey messages. By using Copán's spatial footprint to reconstruct social interaction and visual communication between different architectural groups, patterns can be detected that will help determine if the city's spatial hierarchy mirrors the social hierarchy as defined by the Harvard Typology. However, in order to illustrate how this approach is innovative, it is first necessary to explain how others scholars have studied Maya architecture and space at Copán.

Chapter 3:

Previous Research on Architecture and Space at Copán

> Ideas must be examined in relation to the different conceptual frameworks of which they were a part [Trigger 1989:8].

Many Maya archaeologists have studied settlement patterns; however, none have done so using configurational analysis to simultaneously study “top-down” and “bottom-up” architecture at the scale of the city. To understand why this approach is both useful and unique, it is first necessary to understand how scholars have examined Maya architecture and space at Copán and the types of data that have been used in their interpretations of ancient Maya life. Since access and visibility are fundamental to configurational analysis, it is also important to highlight how previous researchers at the site have studied these aspects of Copán’s layout.

Copán’s architecture and freestanding monuments have long fascinated explorers and researchers alike. The history of exploration, excavation, and research at this site has provided voluminous data that have formed the basis for many interpretations of the function and meaning of Maya architecture. Architectural stratigraphy, hieroglyphic inscriptions, sculpture, iconography, construction materials, and the formal components of architecture and their configurations are among the many elements that have been used to study Copán (e.g. Abrams 1994, 1987; Ahlfeldt 2004; Baudez 1983, 1994; Carrelli 2004; W. Fash and Stuart 1991; Inomata and Houston 2001; Sanders 1989; Schele 1992; Traxler 2004a, 2004b). These investigations are part of larger efforts to study the built environment and the many roles it has “played” in ancient and contemporary societies

(Lawrence and Low 1990). This review begins with early explorers and follows the trajectory of historical thought on Maya architecture and space up to the present.

Early Explorers: A Top-Down Perspective

Early Spanish explorers were the first westerners to visit Copán, and their primary focus was the site's elaborate monumental buildings in the Principal Group. The first known visitor was Dr. Diego Garcia de Palacio, Judge of the Royal Audiencía of Guatemala, who in AD 1576 wrote a letter to King Phillip II of Spain focusing on the ruin's aesthetic qualities, as was common in this era of "discovery and exploration" (Ahlfeldt 2004; W. Fash and Agurcia Fasquelle 2005). He wrote of running into stone "giants" that guided him on to the ruins (Squier 1985:50-51). His narrative suggests that Copán's architecture and open spaces channeled him through the site, facilitating movement along particular paths and restricting access to others.

Colonel Juan Galindo, Governor of the Province of Petén in Central America, was the next known explorer to visit Copán. In AD 1834 he carried out the site's first excavations. His report included a sketch map, drawings of monuments, and cross sections and plans of several structures (Galindo 1836; Hohmann and Vogrin 1982). Unfortunately, most of these documents have been lost; however, a letter he wrote in 1835 to the President of the American Antiquarian Society along with a plan of the Acropolis survives (Figure 3.1). In the same vein as Palacio's, his letter focuses on the aesthetic qualities of the largest temples and freestanding monuments, but unlike his predecessor he notes a common pattern in the spatial arrangement of stelae and altars. He writes, "Opposite this figure [*stela*], at a distance of three or four yards, was commonly placed a stone table or altar" (Galindo 1836:548). In doing so he unknowingly "discovers" something important about Copán: that is its spatial organization is embedded with information about its original occupants.

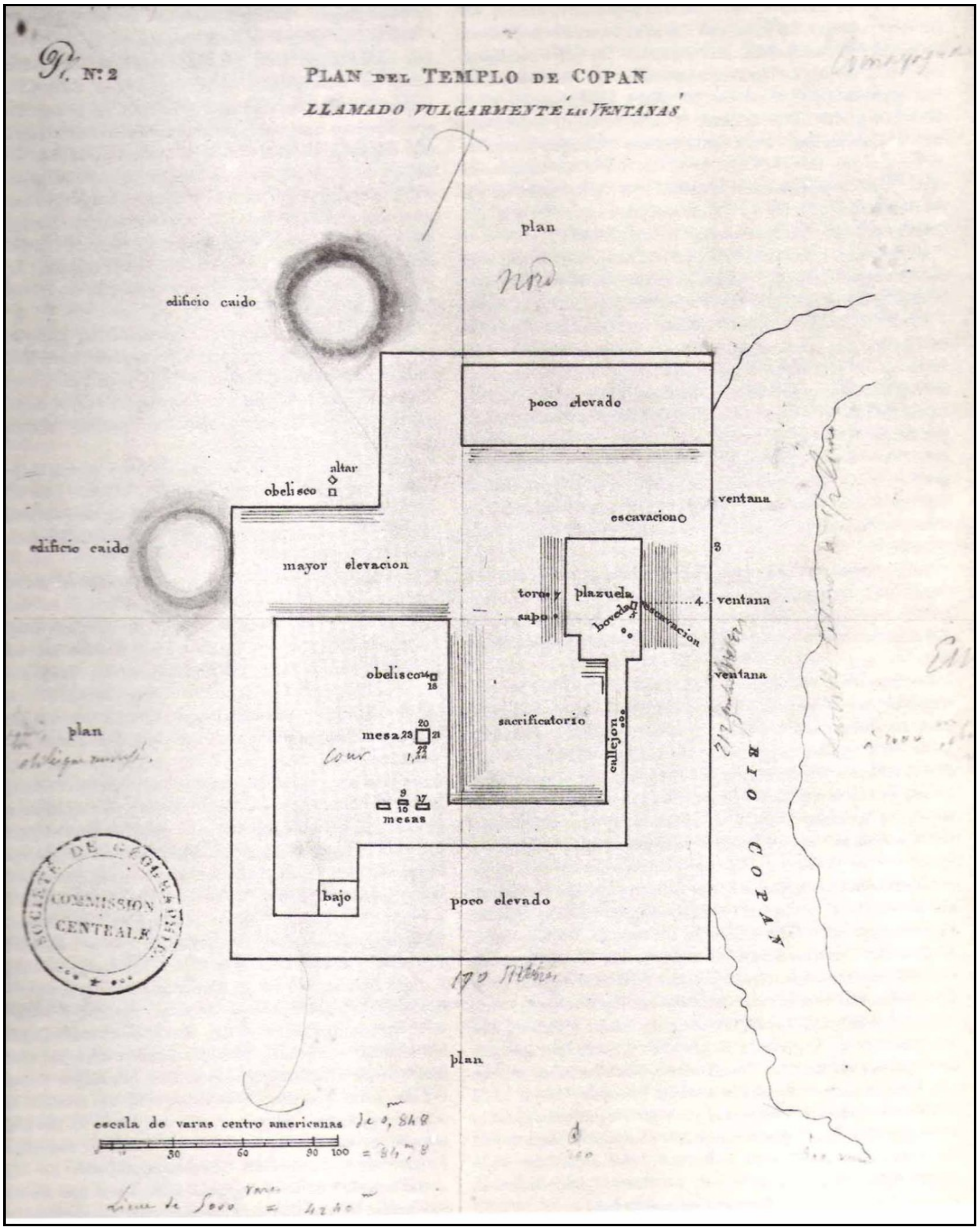


Figure 3.1: **Plan of Acropolis, Copán, drawn by Juan Galindo (from Hohmann and Vogrin 1982:13)**

In AD 1839, the last of these early explorers, John Lloyd Stephens and Frederick Catherwood, journeyed to Copán. While most of their work focused on "evaluating the aesthetic merit of buildings" through descriptive text and drawings (Ahlfeldt 2004:31), they did create a map of Copán's Principal Group. Descriptions that accompany this map contain suggestions of the importance of *access* and *visibility* in the site's organization (Figure 3.2). Stephen's writings include descriptions of four passageways, or gateways, within the Principal Group—as for Palacio—serve as his guide through the ceremonial precinct.

The first gateway runs between two pyramids that lie along the eastern boundary of the Acropolis and appears to have been the "principal entrance from the water" (Stephens 1969:134). The second gateway is a passage about twenty feet wide and leads into a 'quadrangular area' that is surrounded on two sides by massive pyramids (Structure 10L-26 and Structure 10L-11). A third, relatively narrow passage serves as gateway connecting the Court of the Hieroglyphic Stairway to the area directly west of the enclosed space of the Acropolis. The fourth, about thirty feet wide, is located on the south side of the Acropolis and leads about three hundred feet to the East Court.

Stephens not only describes how these passageways restrict access and channel movement through this area, but he also speculates about the significance of such a design. He correlates restricted access to holiness, writing that the East Court—being the most restricted courtyard—must have been the holiest place in the Principal Group, serving as a theatre for 'great events' and 'religious ceremonies'. He is the first to note the potential link between access, architecture, and indigenous meaning.

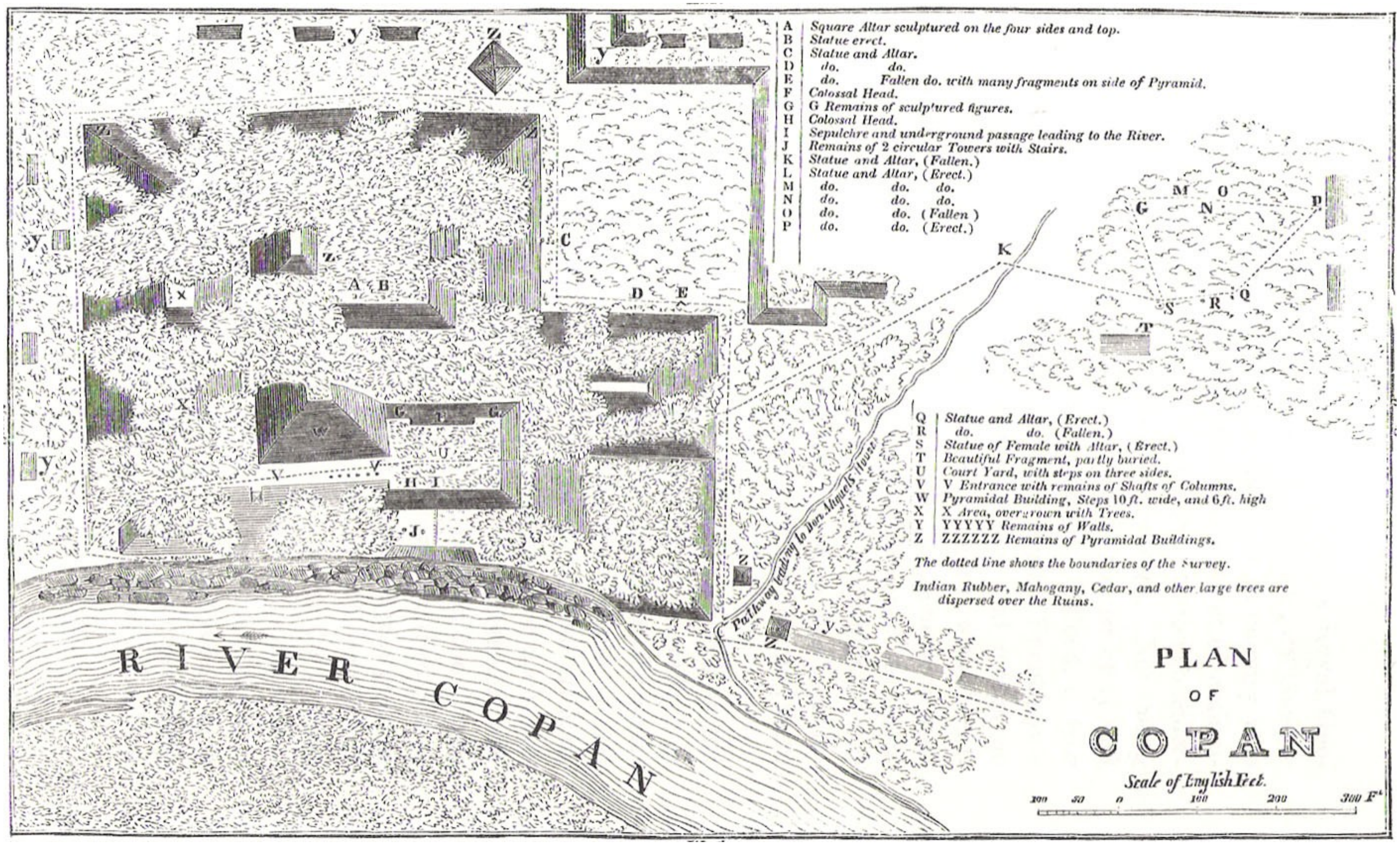


Figure 3.2: **Plan of Copán by John L. Stephens, drawn in AD 1839 (from Stephens 1969:132)**

Stephens' insightful descriptions also hint at the possibility that visibility may have played some sort of role in the city's past. He notes the likelihood that Copán's Principal Group held a commanding "visible" presence in the ancient Maya landscape. He writes,

> All these steps and the pyramidal sides were painted, and the reader may imagine the effect when the whole country was clear of forest, and priests and people were ascending from the outside to the terraces, and thence to the holy places within to pay their adoration in the temple [Stephens 1969:139−40].

Stephens again alludes to the city's visibility as he imagines laborers looking down from the hilltops at the magnificent monuments below (Stephens 1969:146).

Although none of these early explorers explicitly link Copán's spatial organization to an understanding of how the ancient Copanecos lived their daily lives, they all remark on how its buildings and monuments seem to channel them from place to place. In doing so, they are the first to note the importance of accessibility in Copán's spatial layout. Stephens, unlike the others, also realizes that the high visibility of certain buildings is not accidental, but an intentional part of their particular role in the ancient city.

The lack of emphasis on access and visibility in previous research is due to the research goals, which were based on an assumed equivalency of science and objectivity, and it is only recently that studies of perception and indigenous meaning have been recognized as important aspects of archaeological understanding (e.g., Ahlfeldt 2004; Ashmore 1991; Maca 2002; Newsome 2001; Plank 2003, 2004). The external emphasis of their site maps and plan view drawings also limited perspectives on the internal organization of the site.

Pioneers of Scientific Exploration

It was in 1885, almost fifty years after Stephens and Catherwood's exploration, that Alfred Maudslay, the "father" of scientific inquiry at Copán, began archaeological work at the site. Unlike his predecessors, whose artistic approaches emphasized the aesthetic, he sought a more scientific approach that would be useful for "examination" and "comparison" to better understand the ancient Maya (Maudslay and Maudslay 1992:128). His objectives included excavation, producing accurate drawings and detailed descriptions of temples, stelae, and altars, and creating plaster molds of Copán's many carvings and sculpture.

Using these data, he, like his fellow archaeologists, sought to classify archaeological remains and create typologies. Such approaches signified the onset of the cultural-historical paradigm that soon swept through archaeology. The emphasis on culture history developed out of a burgeoning interest in ethnicity among anthropologists, influencing archaeologists to use the geographical distribution of material remains to determine to which ethnic groups various artifacts belonged (Trigger 1989). The goal was to explain geographical and temporal variation in the archaeological record. This theoretical approach influenced archaeological research at Copán from the late nineteenth century into the 1940s, and led Maudslay to be one of the first to consider construction techniques (e.g., roofing elements) and construction materials (e.g., masonry and plaster) as a way to help classify building types. His architectural cross sections and scaled architectural plans are an invaluable dataset. Especially significant are his extensive descriptions, drawings, and photographs of Structure 20, which the Río Copán washed away in the ensuing decades (W. Fash 2001).

Also important are his excavations of Structures 10L-4, 10L-26, 10L-32, 10L-36, and 10L-41 in the Principal Group. He used these data to compare the similarities and differences between Copán's monuments and those at other Maya sites. At the urban scale, he focuses on individual buildings, stelae, and altars and not the spaces that bound or connect them. Nonetheless, he does conjecture that the pyramidal mounds at Copán were "possibly set at different angles on account of astronomical considerations" (Maudslay and Maudslay 1992:130), illustrating his inquisitive nature and scientific mentality, and an awareness of the possibility that the site's organization may have held complex meanings or served special functions in the past.

Following Maudslay's work, Harvard's Peabody Museum carried out a series of expeditions and intensive investigations at Copán (AD 1881–1895). One of these investigators, George Byron Gordon, was the first archaeologist to move beyond the Principal Group and one of his greatest contributions was to create the first topographic map of the entire Copán valley (Figure 3.3). It was during this survey and mapping project that he located several undocumented monuments outside the Principal Group (Gordon 1896; W. Fash 2001). Nevertheless, Gordon still focused on elite culture.

The work of Maudslay, Gordon, and other members of the Peabody Museum expeditions brought about changes in how people thought about Copán. They collected spatial and temporal data that placed the site within its broader cultural context as part of not only the Maya region, but as a whole Mesoamerica. One of the most important changes they brought about was moving beyond the ceremonial complex to document other monuments, which extended Copán's original boundaries and laid the ground for future settlement pattern studies.

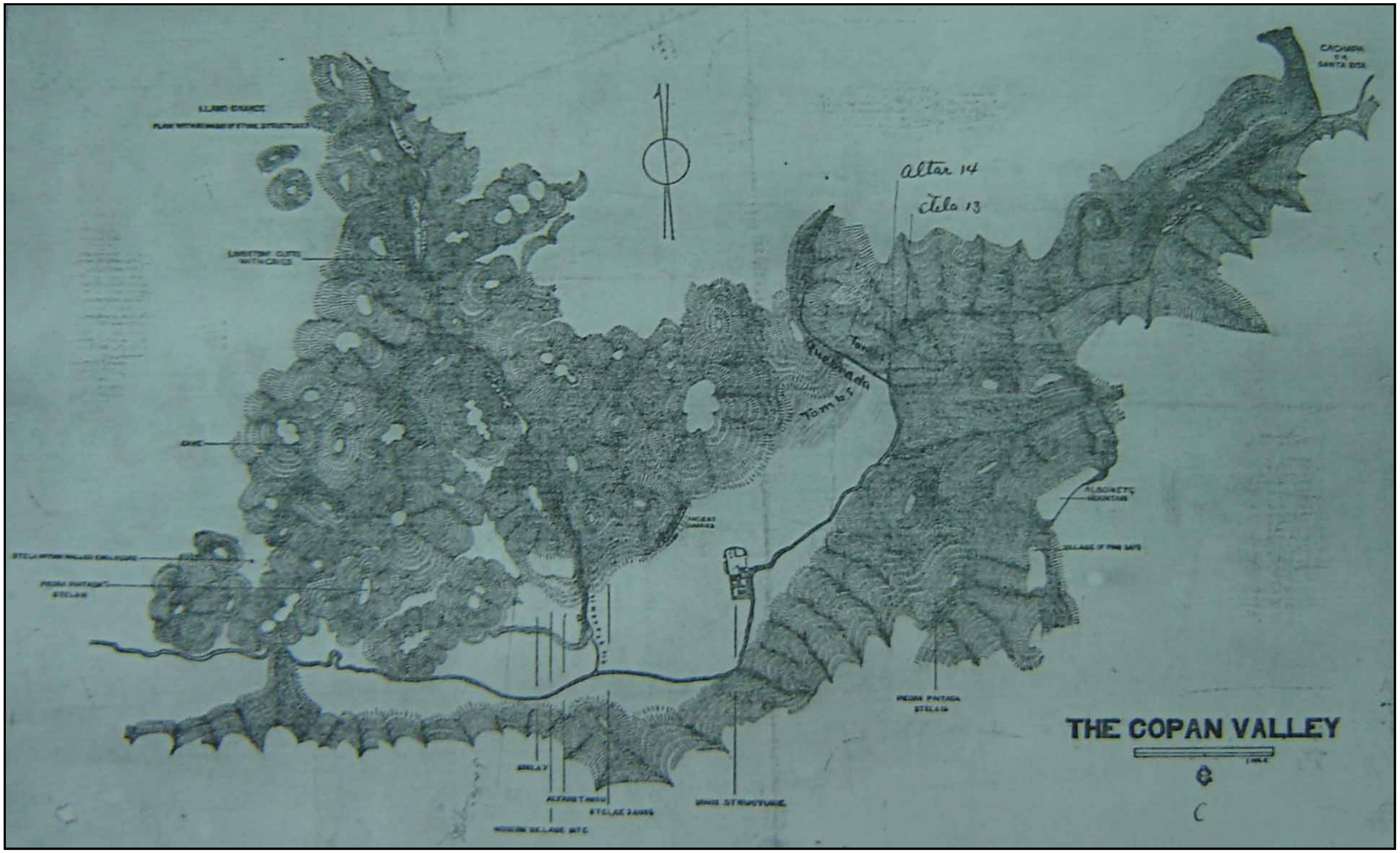


Figure 3.3: **First topographic map of Copán Valley, drawn by G.B. Gordon (1896)**

The Carnegie Institution Era

While archaeologists were focusing on the excavation of large-scale monumental structures, Herbert Joseph Spinden (1913), an art historian, was studying Copán's art. In his seminal work, *A Study of Maya Art*, he deciphered and recorded various artistic themes, then used these data to study the stylistic development of the site's stelae (Morley 1920). He applied this same technique to analysis of development and change in Maya architectural forms (Ahlfeldt 2004), a technique that has been critical to understanding Maya architecture because it provides a temporal context for understanding changes in the use of space at Copán.

Building on the work of Spinden and the Peabody researchers, Sylvanus Griswold Morley, under the auspices of the Carnegie Institution of Washington (CIW), traveled to Copán several times between 1910 and 1919. Like other culture historians, Morley was less interested in the daily activities of Copán's past inhabitants and more interested in broader issues such as the origin and geographic extent of the "Maya Civilization." However, rather than focusing on architecture or art, he studied Copán's hieroglyphic inscriptions. His work provided critical information not only on the chronological sequence of Copán's monuments, but also on their locations. He remarks on the organization of space on two scales: Principal Group and object-level. He considers the Principal Group to be the "site"; thus, he views his work at the Principal Group to be on a site-level scale when he remarks that at the beginning of the Late Classic period, "the center of building activity" shifts about 200 meters south toward the Hieroglyphic Stairway and Acropolis. At a more micro-scale, he astutely observes a correlation between placement of inscriptions and chronological era. He notes that in the Early and

Middle Periods [Early Classic], hieroglyphs appear "exclusively" on stelae and altars, whereas in the Great Period [Late Classic] they extend to architectural elements such as stairways, cornices, wall panels, and door jambs. He does not try to explain the significance of these spatial relationships; however, his observations set the stage for future work on the complexities of space-time relationships at Copán and among the ancient Maya in general.

In 1935, the CIW modified its research design by implementing (1) collaborative efforts with the Honduran government, (2) conservation and restoration techniques, and (3) mapping and excavation strategies that incorporated valley settlements (W. Fash and Agurcia Fasquelle 2005). This approach forms part of a broadly based research design that has become integral to subsequent research projects at the site. During the 1930s and 1940s, the CIW restored several buildings and monuments at Copán, including Ball Court A, Structure 10L-11, Structure 10L-22, the Hieroglyphic Stairway, and the stelae of the Great Plaza.

While the CIW's focus was primarily on buildings as isolated objects (e.g., Stromsvik's restoration of the Hieroglyphic Stairway), CIW researchers also began mapping and excavating some valley settlements. The goal was to situate Copán within its larger site context. Although CIW archaeologists moved beyond single-focus research at the Principal Group, they still adhered to the culture-historical tradition of describing buildings and freestanding monuments, with very little interpretation regarding how the site's inhabitants might have lived in the past. Space itself was not studied, just architectural masses such as buildings, stelae, and altars. Although Maya scholars such as

Proskouriakoff began to situate architecture within broader site contexts, they did so visually rather than within a social-historical context (Figure 3.4).

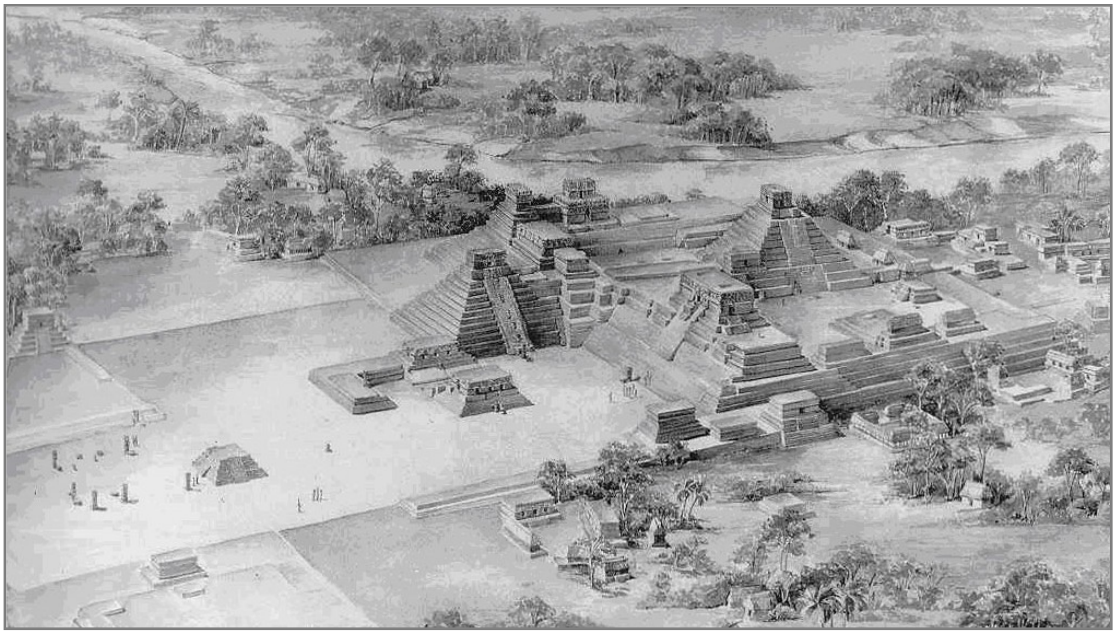


Figure 3.4: **Reconstruction of Principal Group, Copán, drawn by Tatiana Proskouriakoff (1963:33).**

Space Matters: Early Studies on the Design of Space

In the years following the CIW era, archaeologists began to question the objectives of archaeological research; many thought them narrowly focused. Although still dedicated to chronology and geographical comparison, researchers began to think more critically about how they studied ancient cultures. Within Maya studies, it was two art historians, Pal Kelemen (1946) and George Kubler (1962), who took the first steps toward studying archaeological remains from an indigenous perspective (Ahlfeldt 2004). By focusing on the indigenous aesthetics of Maya architecture and thinking about how the built environment may have played a role in past lifeways, they modified traditional thinking and set the stage for future researchers, many of whom, including myself, view architecture and space as *actively* influencing ancient Maya indigenous culture (e.g., Ahlfeldt 2004; Ashmore 1989, 1991; Ashmore and Sabloff 2002, 2003; Plank 2003, 2004).

Emphasizing both mass and volume, Kubler was a pioneer in thinking about the interplay of architecture and space and the indigenous meanings associated with such a built environment. His work suggested that the ancient inhabitants of Mesoamerica conceptualized the units of architecture differently from Westerners and led some scholars to begin to think about the indigenous mindset and about how mass and space *both* functioned as key elements in Pre-Columbian architectural design. This is especially evident at Copán, which Kubler (1962:217) believes is "an assembly of open volumes rather than a collection of buildings." Unfortunately, until the late 1950s, scholars viewed city centers as isolated locales that people entered only for periodic religious ceremonies and worship (Thompson 1970). The importance of "open volumes" was minimized and spaces were seen to serve as the backdrop for religious ceremony rather than playing a direct role in daily interactions. In addition, architectural studies focused on the elite elements of the built environment, including palaces, temples, shrines, ball courts, sweat houses, ceremonial platforms, and mortuary structures (see Andrews 1975 for a 1970s typology of Maya Architecture).

Although most Mayanists continued to focus on individual monuments, they did identify a fairly ubiquitous design for large Maya centers—the "tendency to place the civic and religious centers on natural rises which were leveled and terraced to accommodate the desired architectural arrangement" (Pollock 1965:386). Copán's Principal Group is no different, and its elevated monuments suggest that visibility played a central role in its design. Recent studies carried out by the Early Copán Acropolis Project (ECAP) indicate that the ancient Maya leveled and raised the surface below the Principal Group in accordance with this spatial template (Hall and Viel 2004; Traxler 2004a, 2004b).

The studies of the mid-twentieth century set the groundwork for research from the late 1960s through the 1980s, but it must be kept in mind that they were limited in scope, as most research still was focused on Copán's large civic-ceremonial buildings. Although Kelemen, Kubler, and a few others thought about the role space played in architectural design, most researchers continued to focus on cataloguing structures and recording archaeological data in order to seriate ceramics and create typologies. The culture-historical paradigm—its focus on regional comparisons and changing architectural forms (e.g., Andrews 1975; Pollock 1965)–persisted within Maya archaeology for much of the twentieth century, until the advent of New Archaeology.

Settlement Pattern Studies

While the art historians began to think about spatial context within the Principal Group, archaeologists in the era of "New Archaeology" began to think about space beyond the Principal Group. In the mid 1970s, theory began to play a more central role in archaeological research. Archaeologists began to apply a wide-range of theoretical perspectives and to ask new and different types of questions. New Archaeologists were particularly interested in the hypo-deductive approach, and thus borrowed heavily from such disciplines as geography, ecology, biology, and others with a bent toward hypothesis generation and the scientific method.

Archaeologists were no longer concerned simply with standardized data-collection techniques to ensure comparative datasets among Maya sites. Until the mid 1970s, researchers typically employed top-down perspectives, using the remains of elite culture such as monuments and hieroglyphic inscriptions to say something about the past. With the growing interest in settlement pattern and household studies, scholars began to use a bottom-up perspective, studying non-elite culture to obtain a broader view of ancient Maya society (e.g., Ashmore 1981).

As a result, research at Copán shifted to questions that addressed how people lived in the past, and archaeologists began to ask new questions: *How did the ancient inhabitants of Copán live their daily lives? What did they eat? What types of activities did they engage in? What sort of political and economic systems did they establish?* These questions were used to better understand past land-use strategies, population densities, chronological development, social stratification, agricultural systems, and the functions of peripheral structures (Barnhart 2001).

Consequently, the types of data and the areas from which data were collected also changed. As archaeologists became interested in broader issues, they came to realize that their investigations needed to incorporate a larger spatial extent, and thus they began to carry out investigations outside of the Principal Group, in the surrounding residential areas and the hinterlands (e.g., Baudez 1983; Sanders and Webster 1981; Willey and Leventhal 1979; Willey et al. 1978). These new interests led to new research strategies that prioritized settlement pattern surveys in order to study how the ancient Copanecos situated themselves on the landscape (Bullard 1960; Willey 1956, 1997). As a consequence, researchers became interested in mundane aspects of Copán, including its residential structures, utilitarian wares, and subsistence strategies. By the end of the 1980s studies of household archaeology were burgeoning at the site (Freter 1988, 1992, 2004; Gonlin 1994; Webster and Gonlin 1988).

As part of these efforts, Gordon Willey and Richard Leventhal (Willey and Leventhal 1979; Willey et al. 1978) designed, managed, and carried out the earliest systematic archaeological surveys within the Copán Valley. Their objective was to locate and instrument map residential architecture beyond the Principal Group. Using these survey data, Willey and Leventhal designed the Harvard Site Typology, which classifies house-mounds by socioeconomic status. Test excavations at households throughout the valley have since continued to test the validity of these site types (e.g., Baudez 1983; Freter 1988; Leventhal 1979, 1981; Maca 2002).

Most researchers agree that the Harvard Site Typology is a good predictor of the economic status of an architectural group; however, there is disagreement as to how well it identifies social status, or the roles particular groups played within the valley. For example, a site located in the outskirts of the valley and surrounded by households of lower economic status may play a more prominent social role among its neighbors than a similar site located in the urban core and surrounded by many wealthy neighbors. The typology identifies these sites as the same type even though their occupants most likely played very different social roles. Despite this shortcoming, the Harvard Typology has proven a useful comparative tool and serves as the foundation for most settlement pattern and household archaeology studies at Copán.

In the early years of archaeological survey within the Copán Valley, researchers began to collect settlement pattern data to address basic questions: *What were the* *boundaries of Copán? How much area did the site occupy? What was the site's population in the Late Classic? What was the site's population density in the Late Classic? What were the patterns of land use in the Copán Valley in the Late Classic?* Once these preliminary data were obtained, archaeologists began to study social and economic differentiation at Copán.

These initial settlement studies were followed by Phase I of the Copán Archaeological Project (Proyecto Arqueológico Copán, PAC I), which sought not only an understanding of the site's occupational history, but also to place it within its broader environmental context and move toward a better understanding of the daily lives of the ancient Maya (Baudez 1983). This multi-disciplinary approach enlisted geographers and natural scientists to study botany, precipitation, geology, geomorphology, soils, palynology, and paleoclimatology (W. Fash and Agurcia Fasquelle 2005). Given such interests, researchers not only created site types within the valley, they also categorized the region into five physiographic zones. One of the most valuable contributions of PAC I is a set of twenty-four maps that provide detailed information on both topography and the site's archaeological ruins (W. Fash and Long 1983). Archaeologists involved in the project carried out an intensive and full-coverage survey mapping a 24-square kilometer area of the Copán Valley. These maps were a major data source for this dissertation.

Following PAC I, William Sanders and David Webster of Penn State University co-directed PAC II. The project had two major foci: (1) the excavation of several elite architectural complexes in the urban suburb of Las Sepulturas (Sanders 1986; Webster 1989), and (2) a rural survey documenting archaeological ruins, the natural environment, and ethnographic land use patterns in areas that were not included in the PAC I survey.

The objective was to integrate Copán's urban and rural datasets in order to develop models for a broader understanding of Classic Maya social and political life at Copán.

As a result of their urban studies, Webster (1989) published *The House of Bacabs, Copán, Honduras*, a monograph dedicated to the extensive excavations carried out at Group 9N-8, the largest architectural complex in one of the site's wealthiest suburbs, *Las Sepulturas*. This book forms the cornerstone for many interpretations dealing with the site's sociopolitical system at the end of the Late Classic. Much of the book focuses on a particular building, 9N-82, an elite structure that is known as the "House of the Bacabs" because of its distinctive iconography and epigraphy and is dated to the reign of the 16th ruler, *Yax Pasaj*. The building's façade sculpture depicts a scribe who is believed to represent a lineage head from the lesser nobility. Several scholars believe that this man was vying for power in a weakening and decentralizing Late Classic society—a society troubled by environmental degradation, ideological disintegration, and socioeconomic problems (W. Fash 1989, 2001; Sanders 1989; Webster 2002).

Although interested in the urban environment, Webster has offered a deeper understanding of rural settlements (Webster 1985). Interested in broad regional patterns, he extended the "boundaries" of his research to encompass a larger spatial extent that consisted of Copán's urban core, its surrounding residential areas, and the hinterlands, including the 30-km long main valley and its tributary valleys (Figure 3.5). He and his students have continued the work begun in PAC II by carrying out large-scale excavations at rural households and merging these data with survey data to better understand Copán's settlement patterns (e.g., Webster and Freter 1990; Webster and Gonlin 1988; Webster et al. 1992). These studies focused on reconstructing resource management strategies and subsistence economies to better understand interaction between the elite and non-elite sectors of the society (Webster 2005).

While Webster's research (Webster 1985, Webster and Freter 1990; Webster and Gonlin 1988) used the PAC I and PAC II survey data to undertake additional regionally based analyses, William Fash (1983a) used them to carry out research at the scale of the city. Fash's interests lay in state formation and state-level processes among the ancient Maya, and so while many of his colleagues were focused on ecological variables, he placed greater emphasis on those that were more socially derived (1983a). He integrated ethnographic information about the modern Chorti Maya with settlement pattern data to identify settlement clusters within the Copán Valley. Using a "conceptual Geographic Information System (GIS)," he overlaid archaeological survey data with terrain data in order to posit the existence of twenty ancient settlement clusters within the Copán Pocket, which he referred to as *sian otots*, or "emic rural neighborhoods or sub-community groupings" (W. Fash 1983a:271).

By clustering architectural complexes into neighborhoods, he offered a new understanding of site distribution and social organization at Copán. Unfortunately, very little research has been pursued on Copán's *sian otots* since Fash hypothesized their existence twenty-five years ago (with the exception of Freter 2004). In fact, we have little understanding of the roles these neighborhoods may have played in structuring social interaction in the daily lives of ancient individuals. By combining data from various research projects with recent advances in GIS technology, the importance of sub-communities at Copán can be better understood.

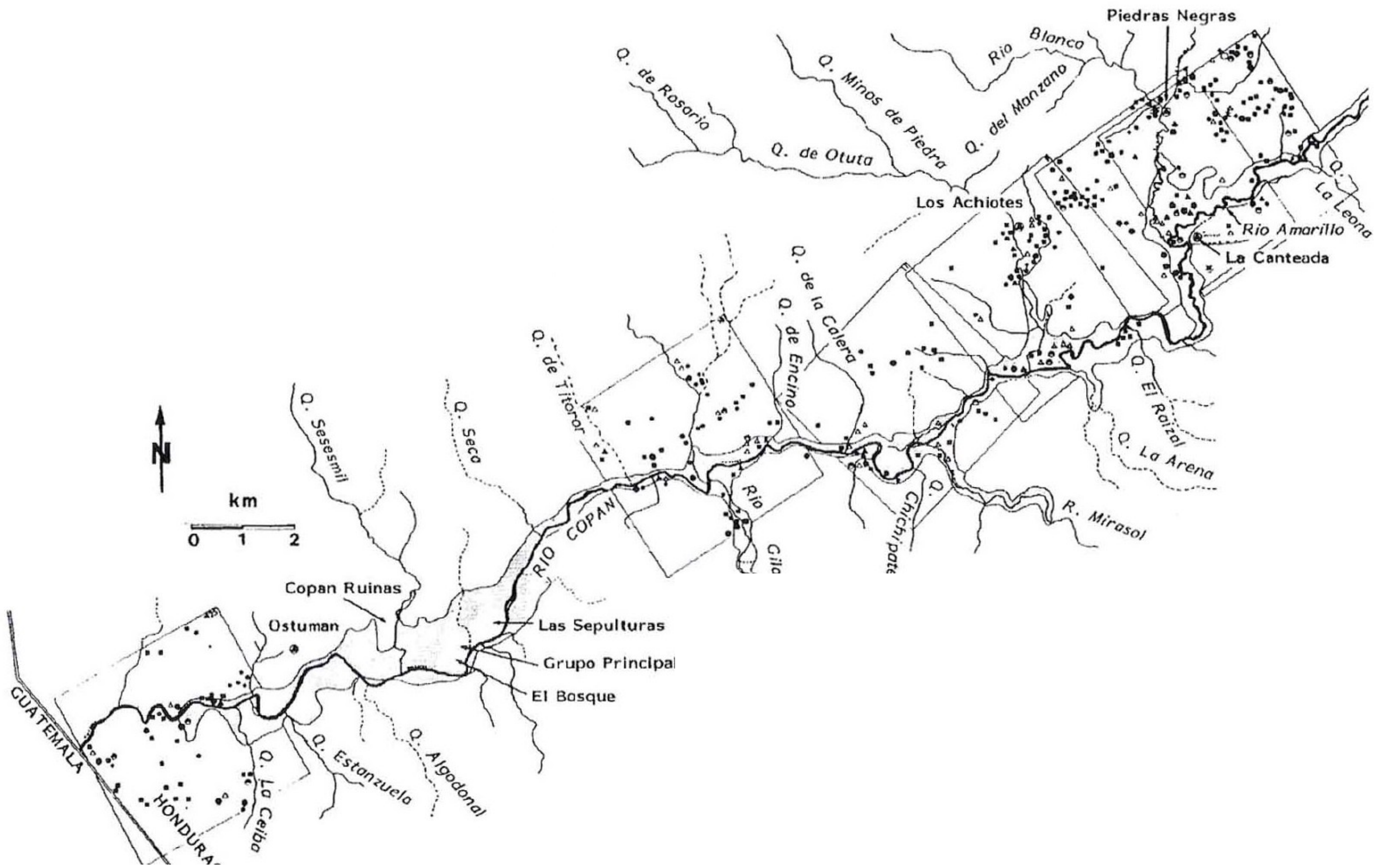


Figure 3.5: **Site distribution map of Copán Valley (modified from Webster 1985:41)**

Integrating Settlement Pattern Data with Architectural Studies

Archaeologists have continued the work begun in the mid 1980s, integrating settlement data with architectural studies to achieve a better understanding of the city's ancient sociopolitical organization. In a recent *Oxford Journal of Archaeology* article, Marion Cutting (2006) reviews several approaches to studying ancient uses of space; researchers have used many of them, and others, at Copán. They include (1) architectural form (2) spatial distribution of activities (3) continuity and standardization (4) relationship between built and non-built space, and (5) architectural energetics.

Studies of architectural form document building and room sizes and shapes along with construction materials and methods to provide information on the general characteristics of architecture (Willey and Leventhal 1979; Willey et al. 1978). This was the predominant method used in establishing the Harvard Site Typology. In contrast, studies of the spatial distribution of activities take into account the spatial arrangement of structures and the activities associated with various structures as well as interior and exterior spaces. Hendon's (1987, 1991) work at Copán helped to better understand how people organized their daily lives and provided information about social differences and social organization.

In looking at continuity in architecture, archaeologists at Copán carried out excavations over relatively small areas (e.g., W. Fash 1989; Maca 2002; Sanders 1989; Webster 1989). This approach allowed them to overlay floor plans from one construction phase on those from another to develop interpretations dealing with socioeconomic change. However, to study standardization, different building forms from across the site needed to be identified, which required extensive research strategies. Similarities and differences in building forms provided more data about social organization (e.g., Hendon 1987, 1991; Plank 2003, 2004).

A few scholars have studied the relationship between built and non-built space to better understand pedestrian movement, visibility, and social interaction. However, they have used qualitative rather than quantitative methods (e.g., Ahlfeldt 2004; Newsome 2001; Sanchez 1997). Architectural energetics, in contrast, uses quantitative methods to calculate construction costs using the volume of materials. However, at Copán Elliot Abrams (1994) also incorporated labor expenditure into his calculations, which resulted in a total cost for structures based on architectural materials and calculated labor-time expenditure. The purpose of such analyses were to evaluate Sanders' (1989) *lineage* model, which viewed Late Classic Copán as a two-stratum society consisting of commoners and a stratified elite who provided administrative or economic services to the site's inhabitants (Abrams 1995). The idea is that higher architectural energetic costs reflect the higher status and power of members of the elite class. Therefore, by calculating energetic costs for the site's Late Classic buildings, the ratio of elite to commoners can be established. Abrams' calculations indicate that Late Classic Copán consisted of approximately 85% commoners, 10% lesser nobility, and 5% highest ranking nobility. While this method provides useful data, its emphasis on tangible materials makes it somewhat narrowly focused—the data need to be integrated with the non-tangible aspects of ancient society (such as access and visibility) that also reflected and shaped ancient sociopolitical organization.

In general, these studies integrating settlement pattern data and traditional architectural data have not only shaped how researchers have come to think about

Copán's social and political structures, they have influenced the broader debate about Mesoamerican elites and the role they played in the organization and complexity of their ancient societies (Chase and Chase 1992). In fact, this research formed part of a larger paradigm that was strongly influenced by Walter Taylor's conjunctive approach to archaeology (Taylor 1948), in which detailed intrasite analyses examining the interrelationships of all artifacts and features are carried out in order to achieve a holistic representation of ancient lifeways (Trigger 2006). In other words, archaeologists began to contextualize their research by documenting and analyzing multiple aspects of a site.

Contextualized Approaches

Although settlement pattern studies dominated archaeological investigations during the 1970s and early 1980s, research also continued within the urban core (e.g., Baudez 1989, 1994; Schele 1992). Studies centered on epigraphy and iconography in the Principal Group and in *Las Sepulturas* (Figure 3.6) because previous research indicated that much of Copán's iconography and hieroglyphs were located in these two areas. As a consequence, the Copán Mosaics Project (CMP), directed by Barbara Fash, William Fash, and Rudy Larios, which began in 1985, was also centered on these areas.

The major objectives of the CMP were to reconstruct building facades, to decipher imagery, and to correlate these data with archaeological evidence (B. Fash et al. 1992; W. Fash 2001; W. Fash et al. 1992). Influenced by the Postprocessual emphasis on human agency and symbolic representations (Hodder 1986; Trigger 1989), CMP scholars focused upon ideology. Seeking to understand the roles art, text, and architecture played in ideological adaptation in Late Classic Copán, they inferred that as ideas and beliefs were shaped, maintained, or reshaped, depending on Copán's broader societal needs, ideology was used to either maintain social cohesion or incite social change (Abercrombie et al. 1980; W. Fash and Agurcia Fasquelle 2005).

Hieroglyphs on Structure 10L-11, Principal Group

Residential Group in Group 9N-8, Las Sepulturas

Mosaic Sculpture on Building Façade in Group 9N-8, Las Sepulturas

Iconography on Building Façade in Group 9N-8, Las Sepulturas

***Figure 3.6:* Architecture, epigraphy, and iconography from Copán**

Extending the objectives of the CMP, Barbara Fash and William Fash began the Hieroglyphic Stairway Project in 1986. They pieced together inscriptions from the Hieroglyphic Stairway (Structure 10L-26) in order to reconstruct historical events and thus provide a historical context for interpretations of ancient Copán. Given that a building's imagery was believed to visually help communicate its function (W. Fash and

B. Fash 1996), data from the Copán Mosaics Project and the Hieroglyphic Stairway Project were combined to investigate the relationship of building function and construction campaigns to sociopolitical and ideological change (W. Fash 1988; W. Fash and B. Fash 1996). Comparative data from the PAC I and PAC II investigations were used to test the reliability of the inscriptions. In this way, the "conjunctive approach"—a contextualized approach integrating multiple datasets (W. Fash and Sharer 1991)—was used to situate Copán's architecture within the site's broader sociopolitical and ideological contexts, providing a more holistic understanding of the site.

The Copán Acropolis Archaeological Project (Proyecto Arqueológico Acropolis de Copán, PAAC), 1988–1996 and the Early Copán Acropolis Project (ECAP), 1997–2002, expanded the Hieroglyphic Stairway Project by continuing to reconstruct a diachronic view of Copán's dynastic history. While the Hieroglyphic Stairway Project sought to reconstruct the architectural and religious use of Structure 10L-26 through time, PAAC and ECAP aimed to relate archaeological features of the Acropolis Cut (lateral cutting of Copán River exposed architectural stratigraphy along eastside of Acropolis) to features buried under the East and West Courts of the Acropolis (Bell et al. 2004; Sharer et al. 1992). The data from these projects are critical to reconstructing Copán's long, complex political history, given the palimpsest that comprises the Principal Group. Data on architectural stratigraphy are also necessary to correlate spatial patterns to particular ideological, social, and political principles.

The spatial layout of this ceremonial complex was configured and reconfigured over time, with newer buildings constructed atop older ones. These reconfigurations resulted in multiple construction episodes that needed to be disentangled before any information embedded within the architectural strata and monuments could be interpreted. To decipher the range of meanings inscribed in stone and space at Copán requires the identification of spatial patterns and is possible only with reliable records of architectural stratigraphy that can be correlated to other lines of evidence (Figures 3.7 and 3.8).

Beginning with the first phase of the Copán Archaeological Project (Baudez 1983), archaeologists set out to map and reconstruct the structures and plazas of the Principal Group using tunneling and excavations. They drew schematic cross sections of structures and plaza floors to classify the site's construction history and the chronological relationships of buildings within this main group (e.g., Cheek 1983; Cheek and Embree 1983). They also collected data on sculpture, burials, and other archaeological evidence within the now-encased structures to understand how buildings and spaces changed through time and how these changes related to dynastic history. These data have been critical to our understanding of Copán's history and provide a historical framework for this dissertation research.

In the 1980s and early 1990s two architects collaborated to produce highly detailed maps of many of the structures in the Principal Group and *Las Sepulturas* (Hohmann 1995; Hohmann and Vogrin 1982). Interested in the analysis of both architectural and spatial organization, their objectives differed slightly from those researchers who had previously mapped the site.

The earlier researchers focused on producing (1) rough schematic plans, (2) precise representations of the development or condition of specific buildings, and (3) stratigraphic documentation of individual excavations (Hohmann and Vogrin 1982:137).

In their subsequent work, Hohmann and Vogrin sought to create a “cohesive,” “comprehensive,” and detailed compositional map of Copán, one they could use to study architectural elements, free-standing walls, paved areas, construction methods, function, and spatial arrangements and alignments. Their maps are indeed comprehensive and allow for multi-scalar analysis, but unfortunately they do not extend beyond the scale of “architectural complex,” that is, the Principal Group and Las Sepulturas. They were interested in examining spatial relationships within Copán’s urban core, not among the valley’s many sub-communities.

Overall, the Copán Mosaics Project, the Hieroglyphic Stairway Project, PAAC, and ECAP investigations have provided fundamental data about Copán’s dynastic history, construction campaigns, and diachronic use of architecture and space. They have been conjoined with survey data to either collaborate or refute interpretations of imagery and building function and to provide a more complete understanding of how the ancient Maya lived at Copán.

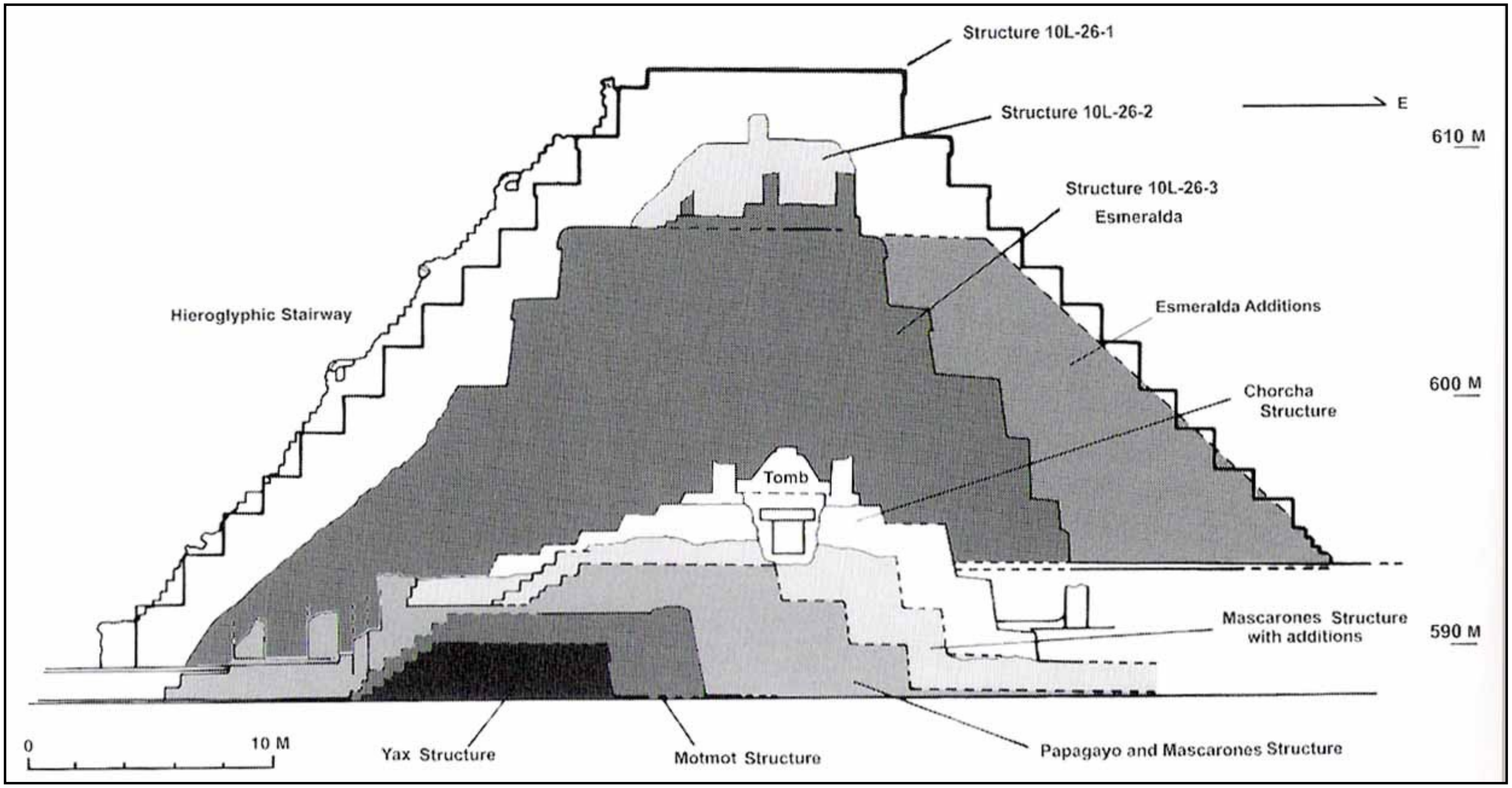


Figure 3.7: **Drawing of architectural stratigraphy of Structure 10L-26 (from Fash 2001:96)**

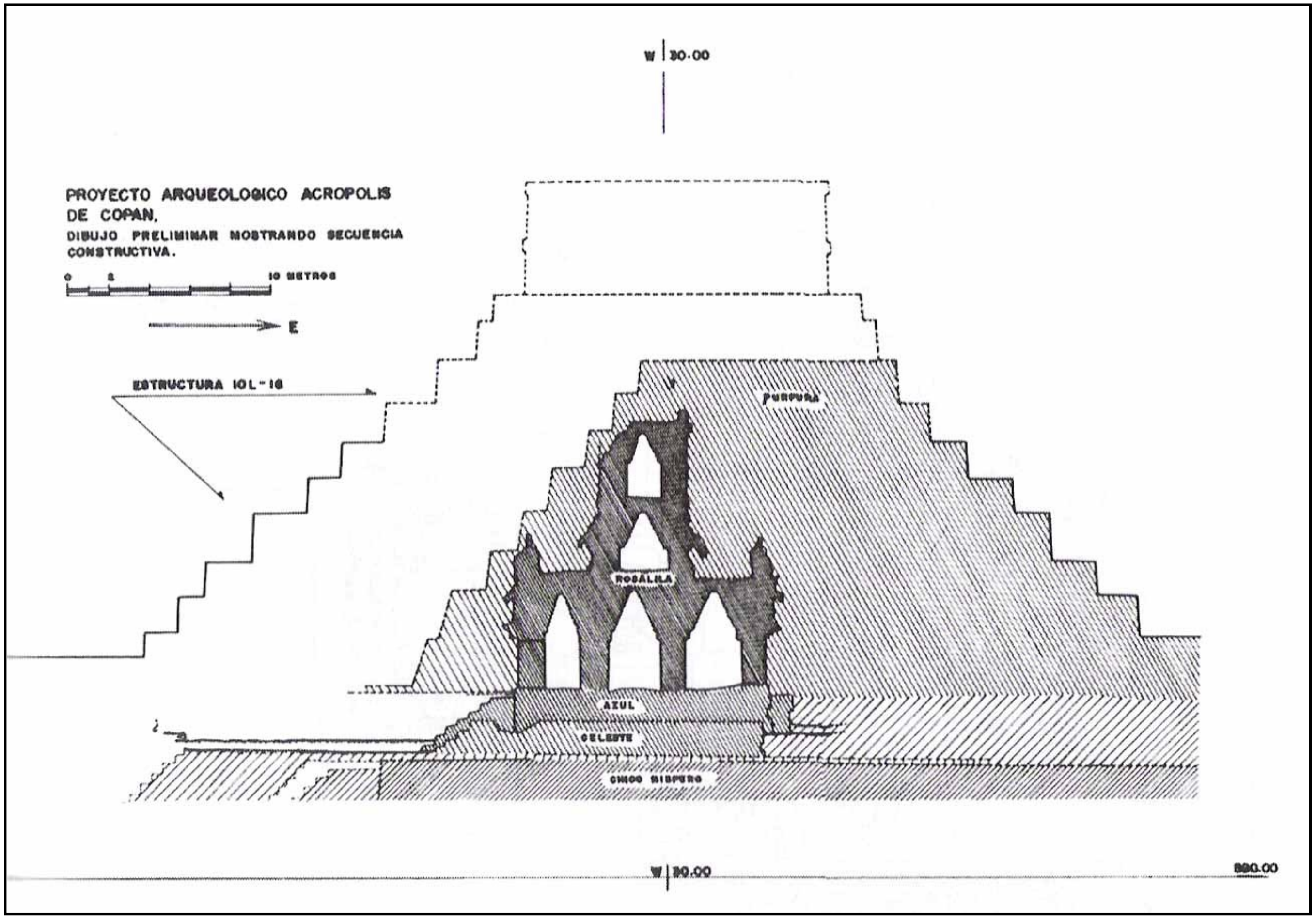


Figure 3.8: **Drawing of architectural stratigraphy of Structure 10L-16 (from Agurcia Fasquelle et al. 1996:193)**

Cosmological Arrangements and Archaeoastronomical Alignments

As contextual approaches became more commonplace within Maya studies, researchers became reacquainted with the work of Kelemen (1946) and Kubler (1962), and they began to investigate architecture with respect to its orientation and spatial layout. Believing that Maya architectural design reflects the symbolic, ideational, and sociopolitical aspects of Maya life, Wendy Ashmore, using Coggins' (1980) directional model, argued that two major principles typically influenced spatial patterning at ancient Maya sites: (1) directionality and 2) political affiliation through emulation of civic architecture. She believed that such cosmological principles shaped the built environment on many scales. Thus, microcosms of ancient site planning and spatial organization should be evident not only in a site's monumental architecture but also within its residential architecture (e.g., Bourdieu 1977; Hodder 1994).

Ashmore tested this hypothesis during the 1988 and 1989 field seasons, in which she excavated the North Group, comprising two architectural courtyard groups (Groups 8L-10 and 8L-12), in the *Salamar* area of Copán (Ashmore 1991; Ashmore and Sabloff 2002, 2003). By comparing the spatial layout of the North Group to its iconography, epigraphy, burials, and artifact caches, she contextualized the compound's space and reached a very interesting conclusion.The group as a whole replicates the plan of the Principal Group. The more open and accessible north complex, 8L-10, with its abstract iconography linked to ritual, royalty, and the heavens, mimics the public space of the Great Plaza. In contrast, the more enclosed south complex, 8L-12, with its more personalized setting associated with "worldly and underworld affairs" (Ashmore 1991:216), resembles the more restricted space of the Acropolis and was most likely a locus of ritual activity. Her conclusions are supported not only by traditional archaeological materials, but also by the differing accessibility and visibility of these two compounds. She writes of the North Group that its visual effect is "one of enclosed or private space in 8L-12 and open or public space in its northern neighbor [8L-10]" (Ashmore 1991:215). Both the orientation and access of the North Group duplicate the patterns seen in the Principal Group (Figure 3.9).

Other scholars emulated Ashmore's seminal work and began to investigate the spatial alignments and spatial arrangements of other structures and monuments at the site. Unique to Copán and nearby Quiriguá is the positioning of many of their freestanding monuments (Baudez 1994; B. Fash et al. 1992; Newsome 2001; Vogrin 1989). The ancient Maya typically placed their stelae in front of, on top of, or inside of buildings; however, beginning with Ruler 13, *Waxaklajun Ub'ah K'awil*, the freestanding monuments in Copán's Great Plaza break tradition. Many of the stelae erected between AD 721 and AD 761 appear to have been aligned to older stelae (Vogrin 1989). Annegrette Vogrin (1989) believes that this phenomenon reflects some sort of ideological innovation that occurred during the reign of Ruler 13.

Elizabeth Newsome (2001) examined Ruler 13's possible political motives for breaking with Maya tradition and positioning seven of his stelae within the open space of the Great Plaza. She concludes that the stelae structure the flow of movement by depicting imagery that acts as a collective text to recount Ruler 13's journey to the underworld. According to Newsome, as the narrative unfolds through time and space, a circuit is created that channels pedestrian movement from stela to stela. Given the Mesoamerican tradition of linking sacred spaces, movement, and ritual worship (Hanks

1990; Orr 2001), Newsome argues that this ritual circuit actually served to transform the Great Plaza into a mythological place associated with power, transformation, and the underworld. This interpretation supports the assertion that stelae serve as symbolic portals to the underworld, places in which living rulers communicated with their dead ancestors (Plank 2003, 2004; Schele and Miller 1996).

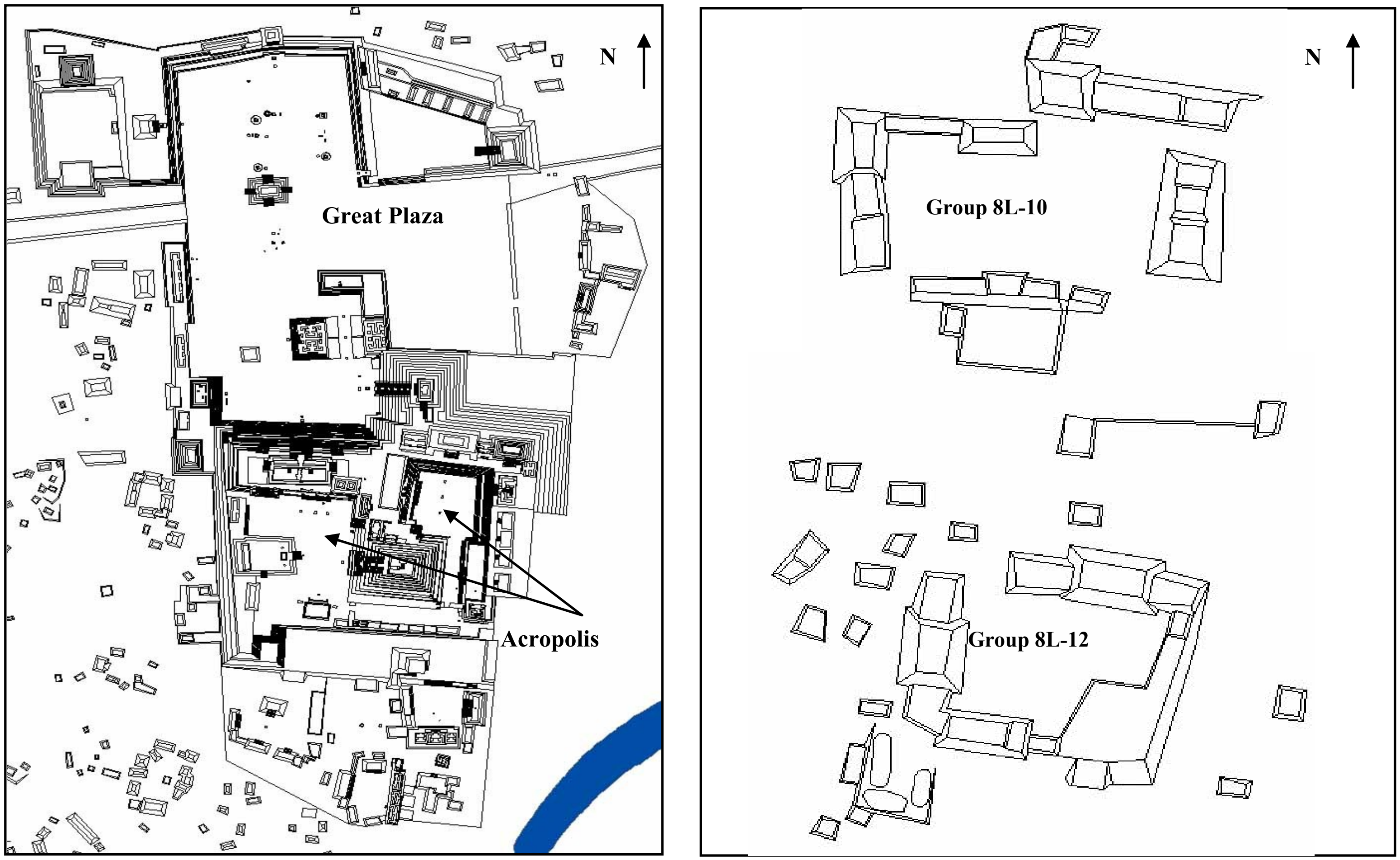


Figure 3.9: **Plan views of Principal Group (left) and North Group (right) illustrating replication of N-S orientation and open, public north groups and enclosed, private south groups**

The idea that specific places within Maya centers acted as portals to the underworld ties together three common themes in Maya cosmology: 1) a multilayered universe; 2) unification of tiers of otherworld via cycles of moon, sun, Venus, and other celestial bodies; and 3) vertical connections in space between natural and supernatural worlds (e.g., caves as portals to the underworld) (Ashmore 1991:200). Together these themes emphasize a multilayered universe with vertical connections. Both Vogrin (1989) and Newsome (2001) touch upon the role verticality may have played in how the ancient Copanecos arranged their monuments.

Vogrin (1989) noted that the stelae of the Great Plaza are not always on the same horizontal plane; thus, some spatial alignments are visible only from elevated locations such as platforms or stairways. Newsome, delving more into the reasons behind this verticality, suggests that it relates to Ruler 13's symbolic journey through the various tiers of the universe as he "regenerates" the earth. By integrating these two perspectives, one literal and the other metaphorical, connections between verticality and visibility can be made and the roles they played in site planning can begin to be understood. Ultimately, the spatial and visual connections between stelae and altars, and the organization of structures, can be further teased out to better understand the complex relationship that existed among access, visibility, and cultural dynamics at Copán.

Summary

For centuries, Copán's elaborate architecture has fascinated explorers and scholars. Early studies were primarily focused on the site's main ceremonial complex, the Principal Group, leading to interpretations about its past inhabitants that were heavily biased toward elite culture. However, with the advent of New Archaeology and settlement pattern research, archaeologists began to move beyond this central precinct and into the hinterlands. While research on the elite and the urban core did not come to a standstill, many researchers began to use a bottom-up perspective focusing on household archaeology and the daily lives of commoners to obtain a bigger, more holistic picture of how the ancient Copanecos lived.

Eventually, contextualized studies combining multiple lines of evidence from both elite and non-elite culture became the norm. In the 1990s scholars began to integrate archaeological, epigraphic, architectural, environmental, and iconographic data to examine the relationships of buildings at Copán within their wider architectural context, a trend that continues today (e.g., Ahlfeldt 2004; Maca 2002; Plank 2003, 2004; W. Fash 2001; Webster 1989; Webster et al. 1998). Although these studies provided a much broader understanding of the roles architecture and space played in the lives of ancient Copanecos and their contributions are invaluable, many of their analyses were still somewhat limited. They imposed boundaries at the scale of courtyard group or architectural complex rather than placing buildings within multiple settings using a multi-scalar approach—one that would allow them to situate architecture and space within multiple contexts moving from isolation to juxtaposition within a courtyard, an architectural complex, its neighboring *sian otot*, the urban core, or even the entirety of the site. However, it must be noted that these limitations do *not* reflect inadequacies in the research, but a necessity to limit the scope of the research because of technological issues that have only recently been resolved with the introduction of new geospatial technologies.

Chapter 4:

Interpretive Framework

The theory of semiotics states that cultural phenomena can be understood as systems of signs (or social configurations) that convey culturally constructed meaning (Bouissac 1998; Burks 1949). The theory provides a framework within which to investigate architecture and space in the Maya world as "participants" that help structure communicative events and convey information within larger historical, ideological, and sociopolitical circumstances (Goffman 1983; Jakobson 1980; Parmentier 1987, 1997; Peirce 1966; Silverstein 1976). Its focus on *addressers* (senders) and a*ddressees* (receivers) provides an ideal context for understanding how access and visibility measurements can be used to reconstruct the connections between site organization, social connectivity, and social order at Copán.

This chapter explains how the theory of social semiotics can be integrated with Geographic Information Systems (GIS) to develop a strong empirical approach to interpreting how the built environment may have shaped social lives at ancient Copán. Section I briefly reviews spatial theories and their influence on anthropological interpretations of spatial organization within the built environment. Section II describes semiotics and explains why it is an ideal framework in which to study sociopolitical interaction and the transmission of culturally meaningful messages to particular social groups. Section III links urban planning among the ancient Maya to a range of site-planning principles, such as access and visibility (and directionality as a subset of visibility), and addresses how these two planning principles in particular are essential to our understanding of ancient Maya sociopolitical organization. Section IV provides an overview of GIS, focusing on recent efforts to incorporate socio-cultural variables into such systems and concludes by bridging social semiotics and GIS, explaining how the two can work together to create a new methodological approach that is firmly rooted in social theory.

(I) Spatial Theories and the Built Environment

In recent years a significant corpus of spatial theory has emerged as many anthropologists, architects, art historians, and other researchers have begun to study the social and cultural factors that influence variation within the built environment (see Lawrence and Low 1990 for a comprehensive review). Early social theorists such as Morgan, Durkheim, and Mauss posited evolutionary and functional theories to explain the built environment's role in social life (Durkheim and Mauss 1963; Morgan 1965). Following these early theories, an interest in symbolic approaches emerged, the most significant being structuralism (Lawrence and Low 1990; Lévi-Strauss 1963). Many of these approaches, however, have been criticized for two reasons: they view buildings and bounded spaces as reflections of culture rather than as vehicles to shape it, and they fail to take into account how processes of historical change affect meaning.

Noting these shortcomings, Bourdieu (1977) and Giddens (1979, 1984) posited practice-oriented perspectives focused on the production and reproduction of social meaning and social relations. They were concerned with “inserting human agency into discussions of history and place” (Lawrence and Low 1990:489), giving an active role to a site’s inhabitants. Nonetheless, these approaches continue to separate time and space by treating spaces as neutral backdrops for social practice rather than as locations with historical significance that play active parts in structuring social lives (A. Smith 2003). More recently, scholars have begun to re-evaluate the potential for semiotic approaches to studying the built environment and its role in social dynamics and political power (Gardin and Peebles 1992; Preucel and Bauer 2001). Semiotics asserts that people have interactive relationships with the built environment—comprised of building forms, bounded spaces–both creating their surroundings and simultaneously finding their behavior influenced by them.

Building on this idea of interactivity, my research uses social semiotics to investigate *how* architecture and space affect the production and reproduction of social relationships (e.g., King 1980; Leone 1984; Moore 2005) by exploring how the built environment communicated messages to Copán's inhabitants. By examining *how* messages were being communicated, we can better understand *what* messages were being sent, to *whom* they were being sent, and *why* they were being sent. Using this knowledge, we can identify patterns of communication between social groups (Rapoport 1969, 1988, 1990), which will in turn help us to study how groups of people interact and how social roles are defined. Ultimately, connections can be made among communicative patterns, the role the built environment played in structuring sociopolitical interaction, and the different social roles played by Copán's inhabitants.

(II) Semiotics

Generally speaking, semiotics is a theory of how meaning is constructed and understood. It is grounded in the notion that cultural phenomena can be understood as systems of signs that convey culturally constructed meaning (Bouissac 1998; Burks 1949). These signs can be expressed through language and materialized in the built environment. The critical point is that they are culturally constructed. This means that objects themselves cannot convey meaning, and therefore technically they are not signs. In order for objects to convey meaning and become signs, they must be situated within a particular cultural, historical, and/or spatial context (Buchler 1978; Jakobson 1980; Morris 1946).

Architectural semiotics, the "semiotics of the built environment," views architectural forms as objects that express culturally constructed values or ideologies (Barthes 1967, 1986; Broadbent 1980; Eco 1986; Gottdiener and Lagopoulos 1986). In this line of thinking, materials, construction, and technology are seen as modifying factors, but they are not form-determinants for the built environment. Instead, it is culture, as a shared system of meanings and symbols that is ultimately responsible for the forms, or morphologies, seen in the built environment (Kent 1984; Rapoport 1969). In turn, these forms act as signs that convey messages. For archaeologists, these signs offer a line of evidence that is critical to understanding sociopolitical, historical, economic, and ideological processes in past cultures (Ashmore 1981, 1986, 1989, 1991; Blanton 1989; DeMarrais et al. 1996; Lawrence and Low 1990; Moore 1996a, 1996b, 2003, 2005).

In the case of the ancient Maya, such signs would have formed a lexicon of architectural forms from which to convey social, political, and ideological messages. However, the lexicon's specific components (e.g., dwellings, shrines, roads, monuments, walls), their configurations, and their placement would have varied through time and across space (Ashmore and Sabloff 2002). The connection between signs and the built environment is a useful one, but the problem is that many architectural semiotic analyses do not consider architectural arrangements or the spaces around them, thereby ignoring the fact that spatial configurations and spatial context work together to convey culturally meaningful messages (e.g., Eco 1986; Preucel and Bauer 2001). However, such shortcomings can be overcome using an alternative view of semiotics.

According to Charles Sanders Peirce (Buchler 1966), a triadic relation exists among signs, objects, and interpretant. In this relationship, not only are objects and signs essential parts of communicative acts, but the actor/speaker is as well (Preucel and Bauer 2001). Moreover, for Peirce (1966) signs are not arbitrary; they can be symbols, icons, or indexes, each of which conveys meaning in specific ways.

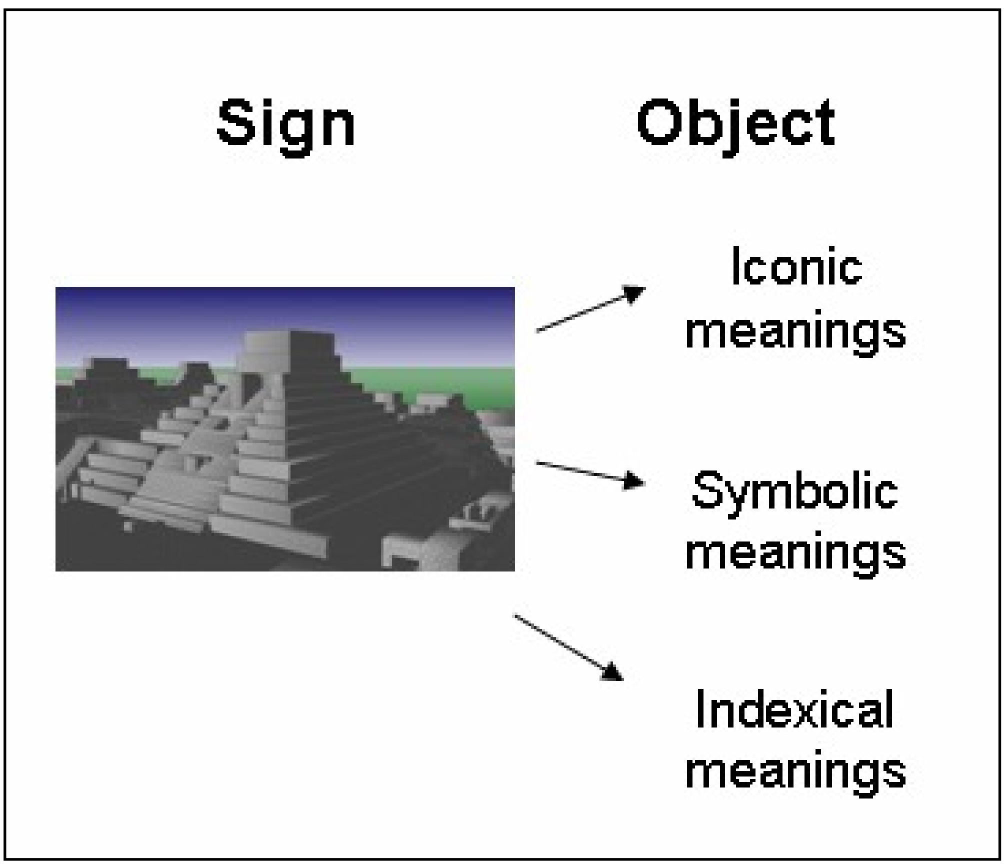


Figure 4.1: **Three ways in which meaning is ascribed to objects in Semiotics**

Symbols reflect abstract ideas or concepts such as power or prestige, whereas icons are recognized because of their formal resemblance to something else. For both, their meanings are dependent upon their contexts (Gardin and Peebles 1992; Jakobson 1980; Parmentier 1986; Peirce 1966; Preucel and Bauer 2001; Silverstein 1976). For example, among the ancient Maya a step-pyramid symbolizes a city's or ruler's power, while its iconic meaning may be that of a sacred mountain (Figure 4.1). Indexes, the third type of sign, are critical to this dissertation because they, unlike symbols and icons, account for spatial context. Architectural indexes are signs that help to structure how people negotiate their physical surroundings (Gardin and Peebles 1992; Jakobson 1980; Parmentier 1986; Peirce 1966; Preucel and Bauer 2001). Indexes assign meaning through adjacency and spatiotemporal context, and they function in two very important ways: (1) they point to the presence of some sort of interaction (e.g., trade), and (2) they channel pedestrian movement by directing how people encounter or negotiate their surroundings. As such, indexes are often conjoined, working together as aggregates, or sign configurations, that are materialized in the built environment as spatial configurations of architecture. This architecture is not limited to elaborate monumental structures, but includes structures from all aspects of society, such as dwellings, kitchens, shrines, terraces, reservoirs, walls, roads, and so forth. In this study, the indexes of interest are the Harvard Typologies five site types because they are presumed to reflect differences in socioeconomic status.

Studying spatial configurations is not new to archaeology; in fact, such work has provided data for many interpretations about past societies (e.g., Ashmore 1991; Glowaki and Malpass 2003). In Maya studies spatial configurations have been used to describe settlement patterns, identify community organization, and detect cosmological orientations (Ashmore 1991; B. Fash 2005; B. Fash and Davis-Salazar 2006; Davis-Salazar 2001, 2003; Willey et al. 1978). However, my approach differs in that it quantitatively measures how such configurations were used to send cues to channel movement and convey visual messages to Copán's different social groups. It focuses both on *how* (via access and visibility) messages were communicated and to *whom* they were communicated in order to investigate how people living at different site types may have interacted with one another.

Although no direct analysis of indexes or sign configurations has been carried out at Copán, Newsome's (2001) study on the relationship between imagery and the spatial arrangement of freestanding monuments in the site's Great Plaza legitimizes the pursuit of such research (Newsome 2001; Sanchez 1997). Her work led her to identify the presence of a stela circuit that structured how people navigated through the plaza. She argued that the imagery inscribed on each monument was part of a narrative that was told over the course of seven stelae, suggesting that the stelae themselves pointed individuals to the next monument in the storyline. In other words, indexes were used to create a ritual circuit that structured the order in which people encountered particular monuments and the spaces surrounding them (Figure 4.2).

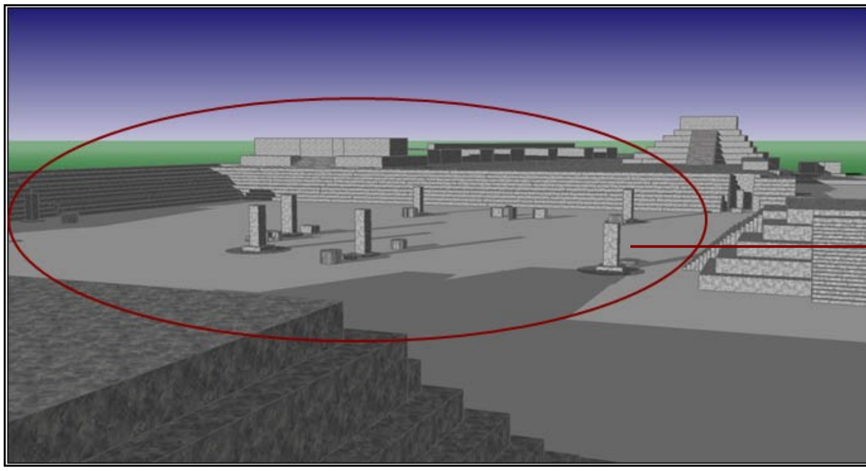



Figure 4.2: Stela Circuit inGreat Plaza of Principal Group at Copán (left) and Stela A (right) (SketchUp Reconstruction from Richards-Rissetto 2007)

Related to indexicality is the fact that signs, whether words in a speech or buildings in the landscape, are directed by someone—the sender (addresser)—to someone—a receiver (addressee) (Goffman 1983; Jakobson 1980; Silverstein 1976). Such discourse is influenced not simply by the words or buildings themselves, but also by the position of the speaker or building in relation to the surroundings (whether it is in relation to people in an audience or to other objects in a landscape). With respect to the built environment, a building's or site's position in the landscape affects its accessibility and visibility not only to members of society as a whole, but to specific groups of people within that society. Via architecture and its access and visibility, individuals living at particular sites produce different types of communication. For example, an elaborate structure that towers over surrounding households sends a message of dominance, while a nondescript household built among many others and below such a monument suggests a subordinate role (Richards 2003).

In fact, Sanchez (1997) in her work at Copán takes a similar, albeit less exhaustive, approach. She examines monumental sculpture as communicative elements and concludes that monuments were placed in specific locations in order to target particular audiences. She compares the imagery found on stelae in the more restricted spaces of the Acropolis and on stelae placed in the more accessible spaces of the Great Plaza. She deduces that mythological imagery showing the ruler interacting with supernatural deities was more common in the upper plazas (in the Acropolis), while portraits of the ruler were more prevalent in the lower plazas (in the Great Plaza). She believes that monuments were placed in specific locations in order to send different messages to different audiences, presumably messages of ideological power to the elite, who had access to the more tightly controlled spaces of the Acropolis, and more general messages about the ruler's status to the wider public (Sanchez 1997:188–190).

Newsome's (2001) and Sanchez's (1997) analyses strongly suggest that social semiotics can provide a foundation from which to delve more deeply into how access, visibility, and the spatial arrangement of architecture influenced message-making, audience, and the channeling of movement among people of different social status at Copán. These studies necessarily lead to understanding the importance of access and spatial configurations in ancient Maya site planning. However, Jennifer Ahlfeldt's (2004) research at Copán provides even greater evidence of the theory's utility. Her analysis of Structure 10L-22 and the East Court incorporates various lines of evidence—iconography, epigraphy, style, construction materials, and other artifacts. In order to establish the potential use(s) of Structure 22, she examines the building not only with respect to form, function, and layout, but also pointedly places it within its historical and ideological contexts. This methodology leads her to thought-provoking interpretations about architecture's multilayered role within Maya cosmology, ritual, and political affairs, and provides a strong argument for semiotic analyses.

In sum, semiotic approaches to the built environment have been criticized for the superficiality of their analyses because they have typically dealt with buildings and constructed space in the abstract (e.g., Saussure 1966). These analyses done without taking into account social and spatial contexts often resulted in ambiguous and problematic interpretations (Gardin and Peebles 1992; Lawrence and Low 1990). Problems arose because architects and others were searching for a standardized architectural vocabulary that would fit all cultures. They believed that universal design components existed and that architectural forms could be identified that would provide social, political, and ideological information cross-culturally.

Consequently, such approaches fell short because they ignored the roles a society's particular social and historical contexts played in the organization and construction of space. However, these problems can be resolved by applying Peirce's view of semiotics, which provides a framework to link the signs within the built environment to their spatial systems and their sociopolitical, ideological, and historical contexts (Gardin and Peebles 1992; Parmentier 1987, 1997; Preucel and Bauer 2001; A. Smith 2003).

(III) Site-Planning Principles among the Ancient Maya

> Most studies of Maya urbanism have focused on morphological criteria; community size, public buildings, etc. At this point, it is the functions of Maya urbanism that we need to learn more about. How did the inhabitants of a given city interact with one another? [Barnhart 2001:93]

Archaeological and epigraphic evidence suggests that ancient Maya constructed spaces to express ideas, beliefs, values, stories, histories, and myths, all of which affected power negotiations and shaped social dynamics. Space, in general, is seen to have acted as an expressive medium that linked to other components of the built environment to convey messages, and studies of spatial organization have therefore long been an important part of Maya studies.

At Copán, architecture and space conveyed information *directly* through inscriptions and imagery, building form, building function, and quality of materials, and more *abstractly* through location, access, and visibility. Messages were constructed not only through text and imagery, but also via facilitators (e.g., *sacbeob* and doorways) and barriers (e.g., walls) that influenced how people moved about the city and *who* was more likely to receive *what* messages. Various site-planning principles were used to construct not only cosmologically meaningful arrangements of structures, monuments, and bounded spaces, but also socially meaningful messages (e.g., Ahlfeldt 2004; Ashmore 1986, 1989, 1991; Ashmore and Sabloff 2002; Blanton 1989; W. Fash 1998; Maca 2002; Moore 1996a, 1996b; Reese-Taylor 2001; Richards 2006; Sanchez 1997; Tate 1992). These messages, in turn, helped to define social groups and influence how people interacted within the site.

Architecture and the built environment both encode and reproduce world views (Ashmore 1991; Basso 1996; Broadbent 1980; Lawrence and Low 1990). Therefore, the spatial organization and placement of specific types of architecture at Copán results not only from environmental conditions, but also from the values and beliefs of its inhabitants. The orientation of buildings, the placement of the site's main causeway, the accessways and gateways into plazas, and the location of elite and commoner residences all affect how meaning was inscribed upon the landscape (Preucel 2000).

Regarding ancient urban design, buildings and spaces would have been constructed to maintain and/or reinforce social forms (Hall 1966; King 1980), and urban planning could these be thought of as a mode of social production. Foucault argues that the built environment is an active agent in controlling people because it contributes to the maintenance of power of one group over another by influencing movement through space (Dreyfus and Rabinow 1983). Many Mayanists agree with this assumption; however, they do not agree upon the degree to which the ancient Maya intentionally planned their cities, and they do not always agree on *how* or *what* aspects of ancient urban planning to study in order to understand the role the built environment may have played in constructing social interaction.

Current Debates about Site Planning among the Ancient Maya

In recent years, the central debate about Mesoamerican urbanism has changed from "*Were this area's large centers truly cities?*" to the presence or absence of urban planning (Andrews 1975; Ashmore and Sabloff 2002, 2003; Barnhart 2001; M. Smith 2003, 2007). Although archaeologists continue to debate the criteria of urbanism (e.g., Childe 1950; Cowgill 2004; Marcus 1983), most agree that the presence of nucleation, social diversity, social networks, monumental architecture, and a relatively large population size constitute a city, and therefore few deny that many large Maya centers, including Copán, are cities; yet many do not believe that such cities exhibit urban planning. This is because traditionally cities are considered planned only if they exhibit "orderly, orthogonal street layouts" (Smith 2007:3); however, the problem with such a viewpoint is that it ignores the variety of urban planning schemes seen in ancient cultures world-wide.

Given that most Mayanists agree that site layouts express specific ideas about the sociopolitical and ideological systems in which they were constructed (e.g., Ashmore and Sabloff 2002; Blanton 1989; Moore 1996, 2005), and that they were often constructed to embody meaning in specific places, it is interesting that many still consider these centers unplanned. The position of this dissertation research is that Maya centers, including Copán, should not be dichotomized as "planned" versus "unplanned," but rather that their organization should be understood, to the extent possible, from an indigenous, or emic, perspective (e.g., Ashmore 1991; Ashmore and Sabloff 2002, 2003; Maca 2002; Plank 2004; Smith 2007). It is not enough to employ western principles of orthogonality; instead, it is important to incorporate the principles of the people who did the planning (Smith 2007).

Wendy Ashmore and Jeremy Sabloff (2002) were among the first scholars to suggest such an approach for the ancient Maya. They argued that the Maya employed a variety of site-planning principles in order to construct meaningfully arranged structures, monuments, and bounded spaces, but that the factors that shaped these site planning principles were numerous and did not necessarily fit western notions of urban planning. This, they argued, was due in part to the fact that many ancient Maya sites have relatively long, complex political histories that have resulted in a palimpsest of multiple construction episodes at a site's center. They suggested that archaeologists can begin to deconstruct such palimpsests by investigating the various factors that contributed to a site's architectural forms and arrangements. In their work, they investigated the role cosmology may have played in strategies of site organization; however, by correlating social, environmental, political, engineering, and historical factors to individual site-planning principles, additional ancient Maya urban planning strategies can be elucidated.

Michael Smith (2003) critiques the Ashmore-Sabloff approach because he believes it lacks a secure empirical foundation in that they fail to use "explicit assumptions and rigorous methods" (M. Smith 2003: 221). In a 2007 article, "Form and Meaning in the Earliest Cities: A New Approach to Urban Planning," he offers an alternative approach. The differences between the Ashmore-Sabloff and Smith paradigms lie more in *what* they chose to study rather than *how* they study it. Ashmore and Sabloff (2002, 2003) focus on cosmological site planning principles, while Smith (2007) emphasizes social and political principles. In actuality, both approaches carry a common theme—spatial principles are fundamental to studying ancient city planning.

Admittedly, Smith offers a more thoroughly developed model that he organizes into two broad categories: (1) the coordinated arrangement of buildings and spaces and (2) standardization. The first part, coordination, is divided into five subcategories: the arrangement of buildings, formality and monumentality of layout, orthogonality, other forms of geometric order, and access and visibility. The second broad category, standardization, has four subcategories: urban architectural inventories, spatial layouts, orientation, and metrology. Smith proposes that these data on arrangement and standardization should be interpreted using Rapoport's (1988) three levels of meaning in the built environment: cosmology (high-level meaning), messages about power, identity, and status (middle-level meaning), and the built environment's role in manipulating movement and shaping behavior (low-level meaning).

Ultimately, both Smith's (2007) and Ashmore and Sabloff's (2002) models provide useful ways of thinking about ancient Maya site planning; however, their shortcomings are that they do not offer very concrete methods by which to actually collect and measure data. Given that they both focus on spatial principles, their differences can be reconciled, and archaeologists can take advantage of the strengths of both by (1) explicitly stating our assumptions about the relationships among social, political, and cosmological variables and site-planning principles, (2) developing empirical methods to collect and measure data, and (3) employing sound theoretical frameworks that drive data collection and guide interpretations. This dissertation research achieves these objectives by approaching these issues in a three specific ways.

First, the research focuses on two site-planning principles, access and visibility, rather than overextending the analysis by trying to understand all possible site-planning principles in the palimpsests of ancient Maya cities. Second, it employs GIS to collect and measure data on access and visibility and then links these data to attributes such as site type, number of patios, and site configuration to identify patterns of communication between social groups. Third, its interpretations are firmly rooted in a theory of social semiotics that explains how communication patterns reflect interaction between Copán's different social groups.

Therefore, in concurrence with recent work (Ashmore and Sabloff 2002, 2003; Smith 2007), this dissertation research begins from the viewpoint that Maya cities must not be dichotomized as "planned" versus "unplanned," and that specific site-planning principles shaping their organization need to be studied to deconstruct the palimpsest of factors influencing site organization. The principles chosen for the investigation are access and visibility, because previous scholarship indicates that they played central roles in communicating and structuring social interaction and/or social segregation in Maya cities.

Why Study Access and Visibility?

In studies of sociopolitical organization, the assumption is that "how people spatially arrange themselves…will affect the frequency and intensity of interaction in a settlement" (Fletcher 1981:121). Spatial configurations influence how people negotiate their surroundings as they "read environmental cues, make judgments about the occupants of settings, and then act accordingly" (Rapoport 1990:139). For example, the placement and organization of architecture can create a sense of axiality by balancing architectural masses along the edges of plazas or *sacbeob*, "which has the effect of directing the participant, both physically and visually, through the space" (Blanton 1989:415).

Access and visibility are key factors influencing such negotiations because they help to communicate information and channel pedestrian movement and, in turn, structure social interaction and community organization (e.g., Batty and Longley 2003; Crown and Kohler 1994; Hammond and Tourtellot 1999; Llobera 2001, 2006; Smith 2007; Tuan 1977; Wheatley and Gillings 2000). Access to particular areas is often restricted, with other portions of a site being more integrated and accessible (Ferguson 1996; Hillier 1999; Hiller and Hanson 1984; Stuardo 2003). The visibility of buildings sends messages that often target members of particular social groups (Higuchi 1983; Llobera 2006; Moore 1996a). The meanings associated with these messages often vary depending on an individual's social status and as a consequence would serve to reinforce existing social relationships or help to shape new relationships. Wendy Ashmore (1992:173) writes of ancient Maya sites.

> They contained pointed and specific messages of power, for their plans generally place the working and/or living quarters of those in power in symbolically paramount locations, thereby asserting that maintenance of order in the universe is bound to perpetuation of the political and social status quo.

When studying the role the built environment played in past social interactions, it is not possible to directly measure interaction; however, it is possible to measure access and visibility, which not only influence communication between groups but also leave evidence of the patterns of communication imprinted in the built environment. With this evidence archaeologists can better understand how different groups of people interacted and how such interactions helped to define social roles in ancient societies.

Previous Archaeological Approaches to Access and Visibility Studies

> Archaeologists have made some progress with formal access analyses of building plans, following the methods of Hillier and Hanson. These studies relate degrees of access of spaces to variables like political control and ritual exclusion. Changing patterns of access- to cities, central administrative ritual/precincts, or individual buildings- can provide information on ancient social inequality and class structure. [Smith 2007:36].

Accessibility (Integration)

For the past twenty years, archaeologists have become increasingly interested in how access to particular spaces influenced social interaction in past communities. *Accessibility* is a general term used to describe the degree to which a system is usable by as many people as possible. In other words, the degree of ease with which it is possible to reach a particular locale from other locations defines accessibility.

Space syntax, an approach that describes relative connectivity and integration between spaces (Batty and Longley 2003; Hillier 1999; Hillier and Hanson 1984), was one of the first methods developed to measure accessibility; however, it has been criticized because it does not directly reveal function nor does it take into account visibility (Ferguson 1996; Webster 1998). In reality, no access analysis can truly reveal function; however, variability in access patterns can be correlated to differentiation, whether social, political, economic, or other (Webster 1998). However, because archaeologists have typically applied access analyses to evaluate access within the same class of architecture, such as Maya palaces, Chacoan Great Houses, or Pueblos of the U.S. Southwest (e.g., Bustard 1996; Ferguson 1996; Shapiro 2005; Stuardo 2003), its potential to identify differences and similarities across social groups has not been investigated.

Despite its shortcomings, space syntax, which uses axial graphs to measure the potential for social interaction to take place, has provided invaluable data for a number of archaeological studies, suggesting that access studies in themselves are useful. For example, Ferguson (1996) found space syntax to be useful at Zuni Pueblo, New Mexico, as he illustrated how changes through time in architectural configurations reflected wider sociopolitical changes. Ferguson's space syntax results indicated that from AD 1400 to 1800 Zuni Pueblo's inhabitants built structures that served to increasingly restrict access to particular spaces within the community. These changes corresponded to on-going threats of Apache and Navajo raids at the pueblo suggesting that these relatively inaccessible areas may have been used to shelter women and children during raids.

In Maya studies, space syntax has been applied to examine differences and similarities in access patterns within royal compounds across the Maya region (Stuardo 2003). An example of such work is Stuardo's (2003) comparisons of access between Classic (AD 250-950) royal architecture at the sites of Palenque, Tikal, and Uaxactún in the southern lowlands and Early Postclassic (AD 950-1250) royal architecture at Uxmal, Labna, Kabah, and Sayil in the northern Yucatan. Stuardo's work demonstrates that simple access patterns existed in the elite architectural complexes of the northern Yucatan, while more complex patterns existed in southern lowland palaces. These differences suggest changes in political organization from the Classic to Early Postclassic periods, which Stuardo believes reflects a Postclassic departure from Classic forms of rulership to a more decentralized system of rulership under a council of nobles (Schele and Freidel 1990). This pattern of increasing political decentralization and a growing sector of powerful nonroyal elite has also been argued for Late Classic Copán (B. Fash

2005; W. Fash 2001; Stomper 2001); however, a very different line of evidence was used to reach this conclusion: iconography from the Acropolis' *Popol Nah* (Structure 10L-22A), or "Council House," and from the "House of Bacabs" (Structure 9N-82). Until now, no access analyses have been carried out at Copán, and although few access analyses have been carried out elsewhere within the Maya region, a preponderance of evidence suggests that they can provide important information about social interaction among the ancient Maya.

Numerous Maya scholars have noted "the obvious intention of Maya builders to channel movement and create visual impressions of sanctity and power" (Webster 2001:40). Royal courts were typically physically elevated and horizontally separated from other residences, and nonroyal elite residences often replicated this same pattern. Interactions within such spaces took place in culturally ordered spatial settings in which "intimate access was restricted to the nobility and invited guests, spatial control being an integral part of the orchestration and wielding of regal power" (Reents-Budet 2001:225).

With a few exceptions, previous Maya scholarship has *assumed* that access played a major role in structuring interactions and conveying messages rather than actually measuring whether or not it truly played such a role. Furthermore, the few empirical studies of access are based on ceremonial and elite architecture. In trying to understand how public monuments and ceremonial architecture convey ideology to different audiences (Moore 1996a, 1996b), researchers have failed to investigate access patterns beyond the scale of individual building or architectural complexes (Smith 2007). No research exists on how access may have influenced interaction at the scale of the city, and consequently there are no data as a basis on which to study how access may have structured interaction between people of different social classes such as the royal elite, nonroyal elite, and commoners.

This is not to downplay the importance of such research, which is critical to our understanding of how access and visibility influence the communicative potential of ceremonial architecture, but rather to point out that more holistic studies are required. In actuality, these earlier studies serve as a foundation for this dissertation research because they have shown that ancient Maya monuments were displayed in varying contexts, from restricted and elite to open and more public. I argue that these principles played important roles in the organization of space at all levels of society—domestic and ritual, elite and non-elite. In order to move beyond Maya rulers and how they may have used built forms and bounded spaces in order to convey messages to specific social groups, other parts of Maya society and their potential influence of spatial organization must also be examined. This requires investigating how other types of architecture, beyond those found within a site's major ceremonial complex, may have been used to convey information and structure social interaction.

One study within the Maya region does move beyond ceremonial architecture and suggest how individuals other than the ruler may have used access to control interaction. Andrea Gerstle (1987), in her study on ethnic diversity and the possible presence of a *Lenca* (a non-Maya group) enclave within an elite courtyard group (9N-8) at Copán, touches upon the subject of accessibility. She writes that within Group 9N-8 there was a *Lenca* enclave and that its "apparent lack of access may indicate that the frequency and manner of communication between *it* and the rest of the site was low and quite formalized" (Gerstle 1987:340). She concludes that such a pattern is typically seen when one group is dominant and controls access to a lower-status group. These results support the belief that access played a major role in communicating information and structuring interaction among all parts of ancient Maya society, not only between ruler and ruled.

In sum, previous studies have shown that access helps to communicate information and channel pedestrian movement, which in turn structures social interaction and shapes community organization (e.g., Batty and Longley 2003; Crown and Kohler 1994; Wheatley and Gillings 2000). Although few access analyses exist for the ancient Maya, those that are available have shown that access was a fundamental principle of site organization that was often used to send messages to particular audiences within ceremonial precincts (Sanchez 1997). Studies of palaces and other elite compounds have correlated controlled access to social and political control (Gerstle 1987; Stuardo 2003).

The most common method of studying the effects of access on social interaction has been space syntax. Despite its limitations, space syntax has proven useful in two ways. First, archaeologists have used the approach to correlate differences in access to social control and inequality (Shapiro 2005; Webster 1998). Second, the approach introduces the concept of integration, which states that the potential for social interaction to take place can be measured using access analyses (Ferguson 1996; Hillier 1999; Hillier and Hanson 1984; Shapiro 2005). Its shortcoming, however, is that it measures integration using axial graphs that rely on simple longest-line-of-sight mapping derived from planimetric representations (Ratti 2005), rather than using a three-dimensional dataset that accounts for topography and building heights, measuring access from a certain point in space and averaging the cost of travel to all other relevant points (Ratti 2005).

Regardless of space syntax's utility, Ferguson (1996) and others are quick to point out that because the method fails to take visibility into account, it provides only a partial view of patterns of social interaction. This is especially true for the ancient Maya, who used the principle of "architectural vertical zonation" to link elevated architecture to cosmic order (Gerstle 1987; Messenger 1987; Moore 1996a). When visual access is blocked, visibility is a powerful factor in facilitating or deterring social interaction, as is the case with the elevated plazas of Copán's Acropolis, people are not encouraged to enter into these spaces. Because access and visibility were important elements in Maya architecture, they need to be integral parts of studies seeking to understand how patterns of communication reflect interaction among different groups of people.

Visibility

Traditionally, archaeologists have emphasized the role of access in shaping social interaction; however, recent work on visibility indicates that it also plays a role in social interaction. Visibility is considered fundamental in many disciplines that study interaction between humans and their environments (Ratti 2005). In archaeology, visibility is typically thought of as affecting perception of inhabited landscape, and as with access studies, most research focuses on the visibility of monuments. The importance of visibility in the study of ancient monuments was first documented in the early eighteenth century in reference to European megaliths. Since then, visibility has been considered an important factor in the location and construction of other archaeological features, including hillforts, watch towers, temples, pyramids, and the like (Van Leusen 2002).

The earliest visibility studies in the Maya region focused on astronomical alignments among structures, freestanding monuments, and the sky (e.g., Aveni 1993, 2001). These studies of archaeoastronomy, along with ethnographic studies suggesting that Maya spaces are often marked by site lines, inspired researchers to see if perhaps non-astronomical lines-of-sight existed between monuments within sites (Hanks 1990; Vogrin 1989), and line-of-sight axes have in fact been noted among Copán's buildings, altars, and stelae as well as at other Late Classic Maya sites such as Quiriguá and Tikal (Aveni and Hartung 1986; Vogrin 1989).

Recently, however, research has moved away from line-of-sight analyses that focus only on intervisibility between two objects, to studying the relationships that an object may have to the many objects or features found within its viewshed (the area from which it is visible) (Llobera 2006). The term *visualscape* has been coined to refer to "the spatial representation of any visual property generated by, or associated with, a spatial configuration" (Llobera 2003), or in other words, the structure or patterning of visual space. To study visualscapes requires that we "go beyond concentrating exclusively on specific locations and that we examine the patterns as a whole, e.g., where do changes in visibility occur and with what intensity?" (Llobera 2006:149). By employing such an approach archaeologists can identify how different elements in the landscape may delineate areas with different significance and activity patterns. For example, areas of visual change may reflect boundaries between social groups, or between symbolic and more mundane, use areas, or among clusters of features that share similar visibility values (which may indicate cultural groupings).

Visualscapes are important because they can help researchers understand how visibility influences the potential for individuals to be drawn to particular locations in a landscape, increasing the likelihood that they will move through particular locations to get to particular destinations that are seen as "attractive" (Llobera 2001). This is significant because it relates to an object's or feature's communicative potential. Objects with higher visibility have a greater potential to communicate information. Simple line-of-sight measurements cannot provide data on the relationships among multiple objects because they are basically done along a fixed line; however, such data are available from viewsheds, which calculate an object's entire 360° field-of-view. Objects, features, or sites that fall within a viewshed are considered to be affected by the monument, structure, or other architectural element, for which the viewshed was calculated.

Recent work at the Late Classic site of La Milpa, Belize, illustrates the utility of using viewsheds to investigate visibility within ancient Maya landscapes (Hammond and Tourtellot 1999; Tourtellot et al. 2003; Tourtellot et al. 1999). As part of their archaeological investigations, these researchers used viewsheds to investigate the role visibility may have played in organizing large centers located in rugged terrain. The viewshed results indicated that two stelae in two nearby smaller sites, *La Milpa East* and *La Milpa West*, were visible from atop a large temple located at the site's center, *La Milpa Central*. They concluded that the alignment served as a mechanism of cultural integration between *La Milpa Central* and surrounding middle-level sites (Hammond and Tourtellot 1999).

Although the researchers employed viewsheds, their research is similar to earlier line-of-sight studies because they focused on monuments and did not consider other types of architecture. Thus, while this investigation is important in that it supports the premise that visibility acted as a vehicle for social integration among the Classic Maya, its shortcoming is that it did not employ the concept of visualscape to examine the potential significance of other elements in the landscape; in other words, it did not look at the landscape as a whole.

In sum, visibility is an influential component of human social interaction. Previous research on the role visibility played among the ancient Maya suggests that site lines were used for multiple purposes, including creating astronomical alignments and linking central precincts to outlying sites. While work at La Milpa focused on ceremonial architecture, its conclusion that visibility was a key factor in cultural integration opens up the prospect of examining the role visibility may have played in communicating information and structuring interaction in other parts of society.

(IV) Geographic Information Systems (GIS): A Methodological Bridge

Previous research indicates that access and visibility help to structure human interaction by channeling pedestrian movement and sending messages to particular audiences (e.g., Hillier 1999; Hillier and Hanson 1984; Hillier et al. 1993; Llobera 2003, 2006), and thus are part of a suite of site-planning principles used in the organization of architecture and space. This is true both in contemporary and past societies, including the ancient Maya. This dissertation moves beyond earlier Maya studies of access and visibility by studying how groups of people from different social classes, including but not limited to ceremonial precincts, may have interacted. I introduce an innovative methodology that uses GIS to identify patterns of communication among late eighth and early ninth century social groups at Copán (using access and visibility as proxy measurements) and then interpret the results within a semiotic framework.

What is a GIS?

A long list of definitions for GIS exists, but some of the more useful ones include "a computerized tool for solving geographic problems," "a tool for revealing what is otherwise invisible in geographic information," or "a tool for performing operations on geographic data that are too tedious or expensive or inaccurate if performed by hand" (Longley et al. 2005). Generally speaking, a GIS is a type of information system that stores, manages, and analyzes pre-existing spatial and attribute data, but it is also capable of generating new data. Its ability to "organize complex spatial data as a series of separate layers, one for each kind of information—sites, soils, elevation, and so on" makes it ideal for identifying and analyzing relationships among datasets and across scales (Renfrew and Bahn 2005:242). The system is based on the idea that everything happens somewhere, making geographic location one of the most important attributes in science and problem solving, and it is being used to address a wide range of issues in many disciplines, including archaeology.

GIS, Urban Planning, and the Site-Planning Principles of Access and Visibility

Most archaeological studies use GIS to study spatial relationships at the regional scale. Two factors account for this fact. First, there have been and still are many more low-resolution data, which cover large areas, than data fine-grained enough to carry out intra-site analyses. Second, until recently GIS was typically associated with more positivist approaches that concentrated on "dendritic resource-centered networks" rather than on community organization issues such as "day-to-day social networks by which neighbouring families and villages form and maintain a community" (Van Leusen 2002:6). Both of these issues can be overcome.

The paucity of high-resolution data can be overcome in two ways. First, as mapping technologies, such as Total Data Stations (TDM) with Electronic Distance Meters (EDM) and Global Positioning Systems (GPS), become more widely available and less expensive, archaeologists are able to collect higher-resolution GIS data in the field. Second, the ability of GIS to convert large-scale paper maps into spatially referenced digital files allows previously collected high-resolution data to be integrated into a GIS.

Once the issue of data availability has been overcome, GIS becomes an ideal tool for carrying out site-level analyses because "it creates provenanced data, and layers within layers, and then can render these in larger or smaller spatial context within or across the sphere of city settlement" (Maca 2002:73). Furthermore, the unique capabilities of GIS to link spatial and attribute data make it ideal for studying the connections between spatial configurations and ancient urban planning. First, it can be used to identify spatial patterns. Second, it can link these spatial patterns to other attributes such as temporal phase, site type, and associated artifacts, thereby allowing archaeologists to better understand the cultural contexts in which architectural configurations were created.

GIS is especially useful for studies of access and visibility. With GIS archaeologists are no longer forced to take measurements using two-dimensional paper maps; instead, they can use a three-dimensional platform that stores not only *x* and *y* location data, but also *z*-values such as elevation and building heights. Consequently, given the appropriate datasets, archaeologists can take precise measurements of access and visibility, analyze them for spatial patterns, and then investigate the cultural significance of these patterns using other sources of archaeological data, also stored within the GIS.

The ability to carry out three-dimensional analyses is especially important for studies on the ancient Maya, who not only viewed the world as multi-layered, but as recent evidence shows built their surroundings to physically incorporate these many layers (e.g., Ahlfeldt 2004; Ashmore 1991; Coggins 1980; Vogrin 1989). The most obvious examples are evident at ceremonial precincts, where vertical zonation expressed the "vertical succession" of the Maya underworld and heavens (Baudez 1994; Messenger 1987) and tall monuments held "authorizing or witnessing" functions over those who could see them (Houston et al. 2006).

Despite their importance, access and visibility have never been jointly assessed for large Maya urban centers. Until the advent of GIS, the seemingly "unplanned" nature of Maya cities made them difficult to measure. A GIS can accurately measure access and visibility across continuous surfaces, identify spatial patterns, and then link these measurements to other datasets (archaeological, environmental, etc.). The second issue that archaeologists must overcome in order to successfully apply GIS to intra-site analyses, which rely heavily on social rather than environmental variables, relates to criticisms that archaeology often fails to bridge theory with archaeological practice (e.g., Fisher 1999; Hodder 1994), and GIS is no exception.

Current Debates in GIS and Archaeology

Some researchers argue that GIS is strictly a tool. In doing so, they promote the artificial dichotomy that exists between archaeological theory and archaeological practice. Proponents of "GIS, the tool" have limited their analyses to environmental variables at the expense of social/cultural variables, often leading to criticisms of environmental determinism (Daly and Lock 2004). In their defense, two real problems associated with using GIS in cultural studies exist and must be overcome. First, GIS was developed as quantitative software; however, many of the cultural data with which archaeologists deal is qualitative in nature (Lock and Harris 2000). Second, there is a much greater availability of GIS-ready environmental data (e.g., soil layers, hydrology, and terrain). In contrast, social data must be collected, classified, and then converted and/or linked to GIS data before it can be used.

These limitations, however, can be overcome and social/cultural information can be integrated into GIS analyses if they are explicitly grounded in archaeological and/or social theory and interpreted within a society's particular historical, sociopolitical, and ideological circumstances (Llobera 1996; Lock and Harris 2000). If this is to be done, archaeologists cannot employ GIS as an unbiased tool. Instead, they need to think of it as a form of practice that must be situated within archaeological theory; they need to use theory-inspired cultural variables in GIS—realizing that places are socially created as well as linked to both space and time (Tschan et al. 2000). This dissertation follows this recent shift, employing both socio-cultural and environmental variables and situating the GIS analysis in a theoretical framework of semiotics.

From Semiotics to Spatial Discourse: Bridging GIS and Social Theory

Traditional studies view the built environment as a mirror of society, its order and space reflecting how people subconsciously think of their world (Pearson and Richards 1994). Interactions within ancient Maya cities took place in "culturally ordered spatial settings" (Inomata and Houston 2001:7), and information about these interactions is encoded in the built environment (Knowles and Sweetman 2004). This viewpoint assumes that architecture and space acted as passive media in the establishment of sociopolitical relationships. However, ancient Maya cities not only reflect culture, they also shape it, and while Maya scholars agree that "the activities performed within architectural settings were crucial to communication of intended messages," they also agree that "the settings themselves still need intensive study" (Ashmore 1992:173).

Many archaeologists now recognize that architecture and space act as active participants in society (Giddens 1979, 1984; Hodder 1994; Leone 1984; Moore 1996). Both building forms and bounded spaces played significant roles in producing and reproducing past sociopolitical relationships because they helped to communicate meaning and shape human interaction (Giddens 1984; King 1980). As archaeologists and others have begun to reconsider the role of the built environment in shaping human lives, they have also begun to revisit semiotics (e.g., Ahlfeldt 2004; Gardin and Peebles 1992; Preucel and Bauer 2001).

To review, semiotics is grounded in the belief that to understand the *what*, it is necessary to understand the *how*. This means that to investigate messages sent via the built environment, archaeologists must investigate the mechanisms that were used to send those messages. Societies employ a variety of mechanisms to convey information;

however, for archaeologists one of the most useful is spatial configuration. In the case of cities, it is the spatial arrangement and organization of ceremonial buildings, residential households, water management devices, roads, walls, and the like that provide information on function and meaning within the built environment.

Given that semiotics is a theory of *how* meaning is constructed and understood, it provides two fundamental concepts—audience and indexicality—that can be used to "bridge" GIS and social theory. The concept of audience is important because culturally constructed messages are created with a particular audience in mind, which means that people are targeted. This is often accomplished via architecture in the form of barriers and facilitators that either inhibit or facilitate social interaction among different social groups. Access and visibility are two mechanisms that people use to target particular audiences, unlike ancient social interaction, they are directly measurable, an issue of particular importance to archaeologists. The concept of indexicality is also important because it provides a unique, ideal perspective for investigating how architectural arrangements worked together to convey messages and direct sociopolitical interaction.

Indexicality is based on the concept that adjacency and spatiotemporal context are critical elements in communication. Components of the built environment such as buildings, roads, walls, and stairs are often aggregated and organized into spatial configurations (indexes) that convey meaning. These components can be arranged in different ways; however, their meanings change depending on what is placed next to what and on their larger spatial context. Indexes influence social interaction by directing individuals in the course of their encounter with architectural elements, and in doing so they convey messages to specific audiences. Both audience and indexicality can be "measured" using the proxies of access and visibility and the general capabilities of a GIS to identify spatial patterns, or in this case communicative patterns.

By employing empirical methods in a GIS to collect and analyze data on access and visibility and then interpreting these data using a theory of social semiotics, new evidence can be gathered on the connections between ancient Maya site organization and social connectivity. In turn, this information can provide insight into how ancient urban planning may have been used to send messages and structure social interaction. By understanding how messages were sent and the "paths" by which they were sent, we can better understand how different social groups interacted, as well as the broader ideological and sociopolitical practices underlying these interactions.

Access and visibility help to establish, reaffirm, or prohibit relationships between particular social groups by channeling pedestrian movement, restricting or facilitating access, and placing visual messages in specific locations that target particular audiences. Semiotics is a theory of *how* meaning is constructed and understood, and it therefore offers two fundamental concepts, audience and indexicality, by which to study the roles access and visibility may have played in spatial discourse. By *spatial discourse*, I refer to the role spatial configurations played in structuring the communication of ideas within the built environment, or in other words *how* they sent messages that worked to reinforce or actively shift social relationship and ultimately shape human interactions (A. Smith 2003). Such messages reflect an exchange of information, that is, communication, among social groups and their organization can be studied through measurements of access and visibility. In turn, these measurements are used to identify patterns of communication among social groups. These patterns of communication reflect how different groups of people interacted as well as broader ideological and social practices.

Summary and Conclusions

Most Maya studies assume that access and visibility played prominent roles in structuring interactions and conveying messages. While a few studies have investigated access and visibility, no research exists on how access and visibility may have influenced interaction among people of different social groups or at multiple scales. The ancient Maya played out their lives in many arenas and on many spatial scales—courtyard group, "neighborhood," urban core, and site-wide. The connections among these various scales reflect social interaction and illustrate how "small things are connected with the bigger social landscapes in which they are set" (Knowles and Sweetman 2004:7). This dissertation offers an empirical approach that integrates GIS and a theory of semiotics to quantitatively measure access and visibility in order to study social interaction across the many scales of society.

Ancient Maya cities, including Copán, consisted of various architectural components that helped to direct social encounters and structure communicative events. They shaped spatial discourse and influenced *what* messages were sent and to *whom* by actively communicating messages that people differentially received and to which they differentially responded. By using a framework of semiotics to understand *how* messages were being communicated, we can better understand *what* messages were being sent, and to *whom* they were being sent at Late Classic Copán, Honduras.

Chapter 5:

Methods

In the theory of semiotics, meaning and its communication depend not only on historical, ideological, and sociopolitical circumstances but also on spatial context and association. This dissertation seeks to understand how people from different social groups interacted in the late eighth and early ninth centuries at Copán employing a multi-scalar approach to investigate *how* architecture and space communicated information and to *whom* the information was communicated to obtain a better understanding of the relationships among site organization, social connectivity, and sociopolitical organization. A Geographic Information System (GIS) is ideally suited to investigate ancient interaction and communication because GIS is capable of carrying out complex spatial analyses. This study used a GIS to compile old data, generate new data, and measure access and visibility. It also used the GIS to begin to create a three-dimensional (3D) virtual reconstruction in Google SketchUp of Late Classic Copán to provide an interactive model to better understand the spatial relationships among the city's different social groups.

Creating the GIS

Given that this research uses data from the city's configuration as a whole rather than from one or two specific households or architectural complexes, finite temporal control was not always available. Except for those sites that have been excavated, temporal depth often remains unknown; however, from archaeological survey and test excavations, we do know that visible surface remains belong to the Late Classic (W. Fash 2001; Freter 1988; Webster 1985, 2005; Webster et al. 1992, Willey and Leventhal 1979). Consequently, it was necessary to limit the study to remains that are securely dated, in other words, ruins belonging to the end of the Late Classic (i.e., sites mapped in the PAC I settlement survey; see Chapter 3).

The methods employed in this dissertation involved several steps. The first was to design and develop a GIS to store, manage, analyzes and generate spatial data. Spatial data in a GIS are linked to attribute data (such datasets are typically referred to as a GIS data) to allow users to carry out complex spatial analyses. This dissertation research used the Environmental Science Research Institute's (ESRI) GIS software package ArcGIS *9.1* to collect, store, create, edit, and analyze the GIS data. The first step in creating the GIS was to collect and convert any available spatial data for the archaeological site of Copán (see Appendix B for details of GIS data collection and conversion).

Spatial data can be collected in many ways. Methods can include use of a Global Positioning System (GPS), paper maps, digital data, aerial photos, satellite images, and a transit or Total Data Station. Collecting and integrating data into a GIS using paper maps is often time-consuming; however, it is often the only available method when using historical data or data acquired prior to the introduction of GPS and GIS. In the late 1970s, archaeologists working on PAC I mapped the topography, structures, and other archaeological features of the Copán Valley. The result is a volume of 24 one square-kilometer maps. However, for integration into the project's GIS, these maps first needed to be converted from an analog format (paper) to a digital format. Using an oversized scanner, these maps were scanned and saved as Tagged Information File Format (TIFF) files.

Once scanned, TIFF files (raster or pixel-based data) needed to be georeferenced. *Georeferencing* is the process of defining how raster data are sited in map coordinates; in order words, it is the process of aligning scanned data that are not spatially referenced to a real-world coordinate system. In this case, the PAC I maps were aligned to the Universal Transverse Mercator (UTM) Projection. Georeferencing these data was crucial because the process allowed for features such as structures, rivers, and *quebradas* to be directly digitized into shapefiles with real-world coordinates. This meant that these files could be directly overlaid with other GIS data, thus allowing for multiple datasets (e.g., archaeological, ecological, and hydrological) to be simultaneously viewed and analyzed. I chose the UTM coordinate system because the reference scale for the digitized files is automatically in meters, which allows for precise distance measurements of buildings, watercourses, and any other digitized features. However, because the PAC I maps provided only a single *x*, *y* coordinate of Latitude 14°50.4' North and Longitude 89°08.5' for the entire valley, I needed to create a UTM site grid in order to georeference the maps.

This problem was easily solved by using a *Garmin MAP76 GPS* to collect x, y coordinates. In the summer 2005 and 2006 field seasons (Richards 2006), I spent several weeks collecting GPS points for a variety of archaeological features in the valley. The GPS points were collected using the Universal Transverse Mercator (UTM) projection (WGS 1984 UTM Zone 16N). The GPS data were used to create a UTM grid, which could be aligned with the PAC I survey quadrants.

During georeferencing it is necessary to assign a coordinate system that associates the data with a specific location (datum) on the earth. In this case, the northwest corner of Structure 10L-4 in the Great Plaza of the Principal Group served as the datum for the grid. This means that the Principal Group map, on which Structure 10L-4 is located, was imported into the GIS first. Next, the datum was used to assign UTM coordinates to this map. Finally, the grid lines on the map were digitized and then replicated to establish a new UTM site grid. After this process was completed, the remaining 23 PAC I maps were imported into the GIS and georeferenced to this site grid (Figure 5.1).

The PAC I maps provide drawings of the exterior of structures; however, they do not provide details on interior spaces (excepting within the Principal Group). More recent excavations and architectural reconstructions do provide these data, and in some cases higher-resolution data. Maps from several additional sources (Andrews and Bill 2005; Hohmann 1995; Hohmann and Vogrin 1982; Maca 2002; Maca and Wolf 2001) were scanned and georeferenced to the same UTM grid. Figure 5.2 illustrates the georeferencing process for the Comedero *sian otot* in which the contour lines and structures on the left were aligned to the spatially referenced shapefile on the right. This same process was carried out for the Principal Group and Groups 9N-8 and 9M-22 in the suburb of Las Sepulturas. Figure 5.3 juxtaposes the lower-resolution PAC I map with the higher-resolution Hohmann (1995) map of Group 9N-8 (Plazas B, D, and H), as I wanted to include the most detailed and accurate map data in the GIS. After all the maps were scanned and georeferenced, these scanned data (raster data) needed to be converted to vector data (discrete objects) to be usable in the GIS; in this case, they were digitized as shapefiles.

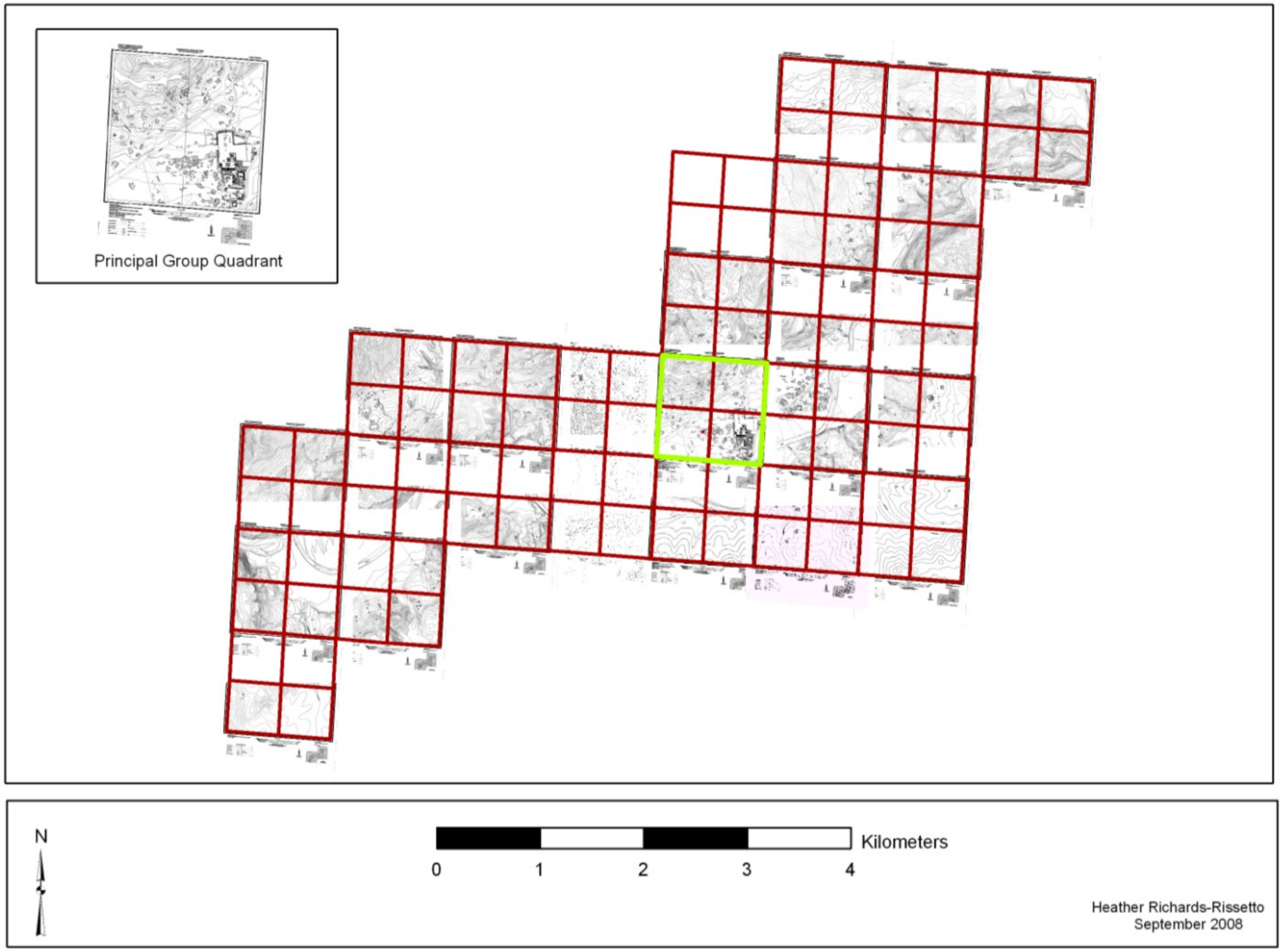


***Figure 5.1:* Georeferenced Proyecto Arqueológico Copán (PAC I) maps with UTM grid (Richards-Rissetto 2007)**

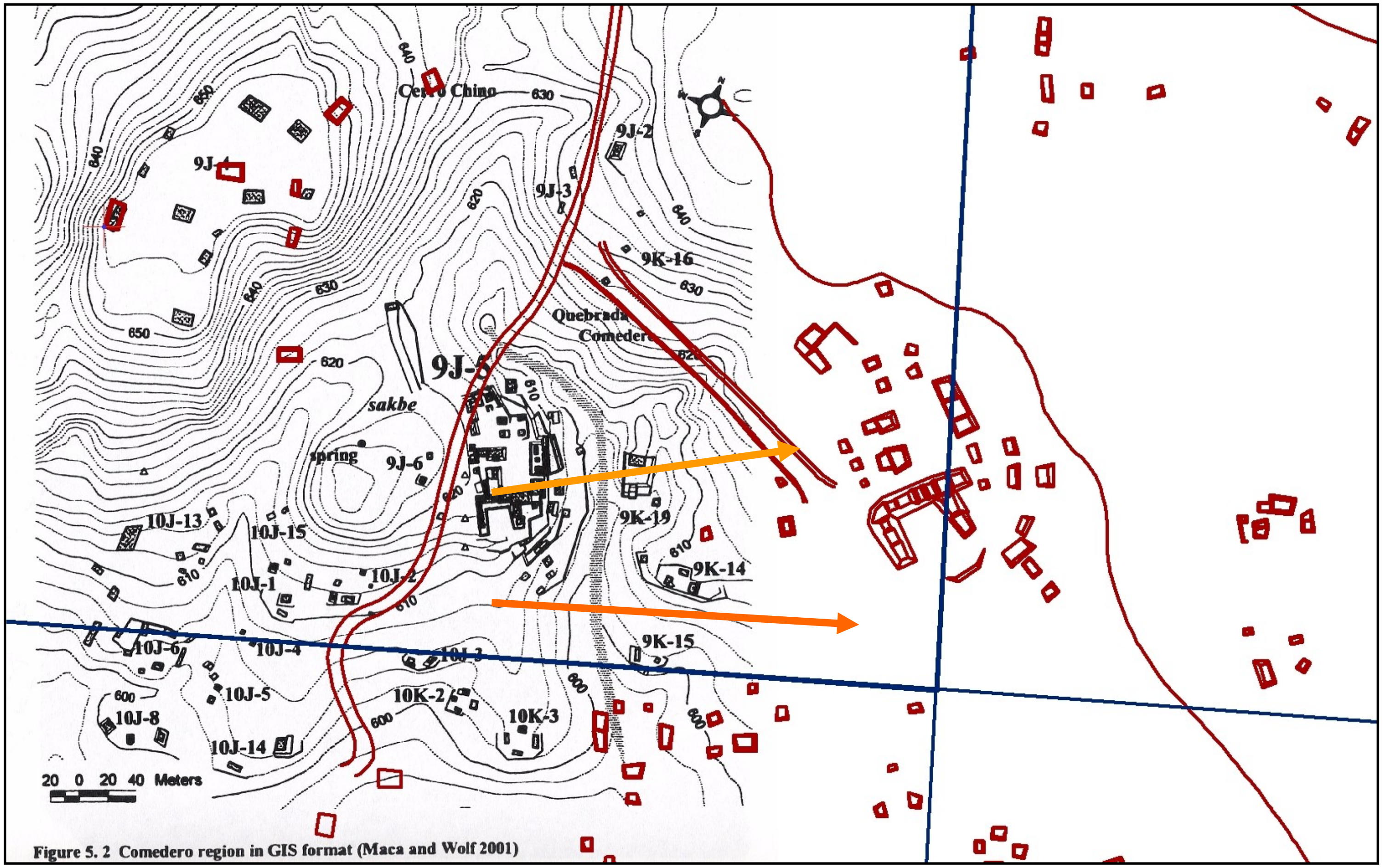


Figure 5.2: **Georeferencing Group 9J-5 (Comedero) using Maca and Wolf 2001 Map—arrows indicate the direction of spatial alignment (Richards-Rissetto 2007)**

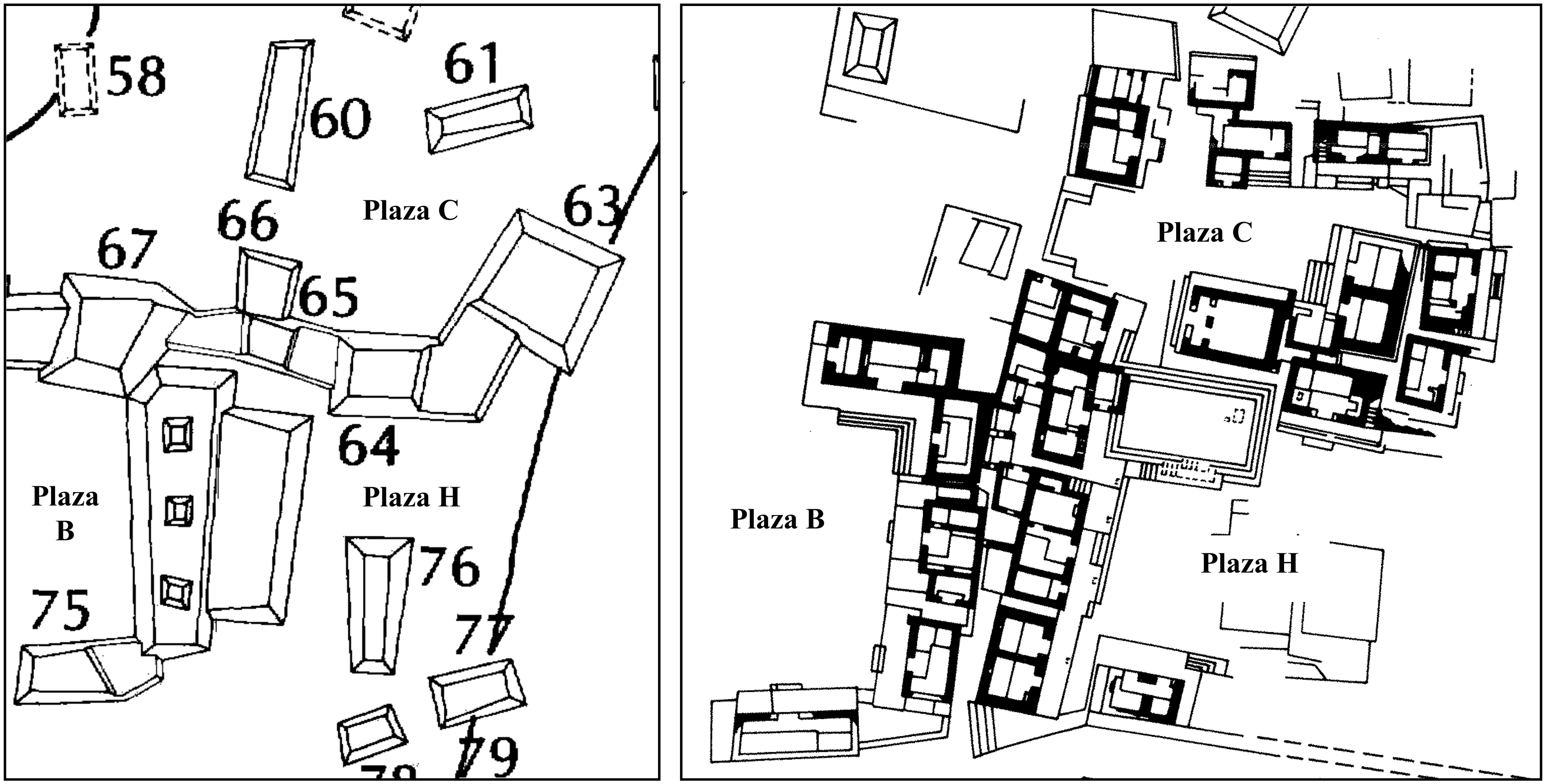


Figure 5.3: **Earlier PAC I map (1983) of Group 9N-8 (left) and updated Hohmann (1995) map (right)**

Creating Shapefiles: The Digitizing Process

There are several options for vectorizing data. One option is to use raster-to-vector software such as WinTopo Professional to automatically vectorize data. However, the option that I used was "heads-up digitizing" or on-screen digitizing—creating new features by tracing their shapes on the computer screen using another layer for reference—because this method is typically more accurate than automatic raster-to-vector methods. Each time a location is clicked on the screen, an *x*, *y* coordinate pair is recorded and stored as part of the feature. In this case, because the scanned maps were georeferenced to the UTM projection, each *x*, *y* coordinate pair corresponds to a UTM reading (Easting and Northing). Although digitizing by hand was an extremely long, time-consuming process (8 months) it was preferable because multiple data layers (e.g., grid lines, structures, topography, hydrology, and labels) were embedded in the maps, and feature lines were often very close together. Another reason it was important to do this process by hand was that the exterior lines of the structures needed to be "closed" (connected) in order to later convert them from lines to polygons.

Three layers were digitized from the maps: (1) *structures*, (2) *contour lines*, (3) *hydrology*, and (4) *sacbeob*. The structures consisted of the five Harvard Typology types and isolated mounds. The contour lines were digitized from the PAC I maps, which had varying contour intervals depending on their location in the valley. Most had 2-meter contour intervals; however, near the margins of the valley these intervals were 5, 10, and sometimes even 20 meters. The hydrology layer comprised the Río Copán, the *quebradas*, and the city's two known reservoirs. The city's eastern and western *sacbeob* were originally digitized from the PAC I maps and edited to reflect more recent excavation and survey data (Hohmann 1995; Maca 2002). After the georeferenced maps were digitized, the *structures* shapefile needed to be converted from lines to polygons.

Converting Lines to Polygons

After all of the structures from the PAC I maps were digitized, they were converted from lines to polygons to give mass to the site's buildings, stairs, walls, and freestanding monuments. This procedure was important for two reasons. First, in order to create a continuous surface to carry out access and visibility analyses, all features must be assigned an *area* value, and it is not possible to calculate area for lines. Second, in order to export these shapefiles and use them in constructing 3D computer models, the site's structures needed to be polygons.

The process of creating polygons used the *Polyline to Polygon* function in the Data Management Toolbox of ArcGIS. Unfortunately this process was not straightforward. In areas where I appended data from different map sources, such as Hohmann and Vogrin's data and the PAC I data for the Principal Group, many of the structures needed to be edited. Dangling lines had to be removed and polygons that were not connected had to be extended for the conversion process to succeed. However, once the data were edited, conversion proceeded smoothly. After all the site's structures were converted to polygons, all shapefiles were ready to be attributed, that is, to be assigned data that described the properties of the points, lines, or polygons in the shapefiles.

Attributing the Shapefiles

At this stage digitized shapefiles had only two basic attributes: FID and Shape. FID is the unique ID number created for each record in the shapefiles attribute table. Shape indicates whether the digitized feature is a point, la ine, or a polygon. Although required in a GIS, these attributes are not very useful for analytical purposes, and additional attributes therefore needed to be added. Attributes such as heights for buildings, stairs, stelae, altars, and *sacbeob*, Elevation, Structure ID, Group ID, Site Type, CPN numbers, and labels (e.g., *quebrada* names) were collected and collated from a wide variety of sources—maps, drawings, and descriptions from PAC I, PAC II, Peabody Museum Publications, several dissertations, *informes* (field reports), articles, monographs, and books.

This process was time-consuming for two reasons: (1) assigning heights to buildings, stairs, walls, stelae, and altars required searching through many different sources, and for many buildings and stairways necessitated calculating heights using architectural drawings or a trigonometric function; and (2) each feature in the shapefiles needed to be individually selected in the ArcGIS map document, then attributed. When architectural and excavation data were available to assign heights, I used them. Architectural plans from Hasso Hohmann and Annegrette Vogrin's *Die Architektur Von Copan* (1982) provided heights for buildings, platforms, terraces, stairways, and freestanding monuments in the Principal Group. Currently, excepting buildings in the Royal Courtyard, these are the best data available for this area, as they were acquired using highly accurate photogrammetric methods. In many cases, the exact heights of individual stairs were not given; however, using platform and terrace heights as well as average stair heights, the heights of individual steps were interpolated. For example, Figure 5.4 shows two scanned architectural drawings. The drawing on the top illustrates a situation in which all individual step heights are provided, and the drawing on the bottom provides an example in which only some are.

In the first procedure, individual step heights were sequentially added so that the values stored in the attribute table were the actual height of the stairway in meters above sea level (masl) rather than individual step heights. This is a critical step in preparing the data for later access and visibility analyses. In the second procedure, an average step height was calculated based on the number of steps and the total height of the structure; then, as in the first example, step heights were sequentially added.

In most cases, Principal Group building heights were acquired from the Hohmann and Vogrin (1982) plans; however, in the case of Structure 10L-22, I used Jennifer Ahlfeldt's (2004) reconstruction. Until recently scholars believed that Structure 10L-22 was a one-story building (e.g., Proskouriakoff 1963); however, Ahlfeldt's work for the Proyecto Templo 22 shows that the building actually had a roof-comb atop its second floor. The addition of this architectural element not only adds several meters to the building's height, but also changes its relationship with the buildings that surround it. To use the most up-to-date and accurate data this feature and its height were added to the *structures* shapefile.

Many of the data for the buildings and free-standing monuments in the Royal Courtyard were acquired from E. Wyllys Andrews' and Cassandra Bill's (2005) recent publication on excavations in this area. Unlike the data (height, width, and length) on the maps, plans, and drawings, these data were embedded in the text. Searching through the text for measurements was also used to attribute structures from excavated contexts in areas outside of the Principal Group.

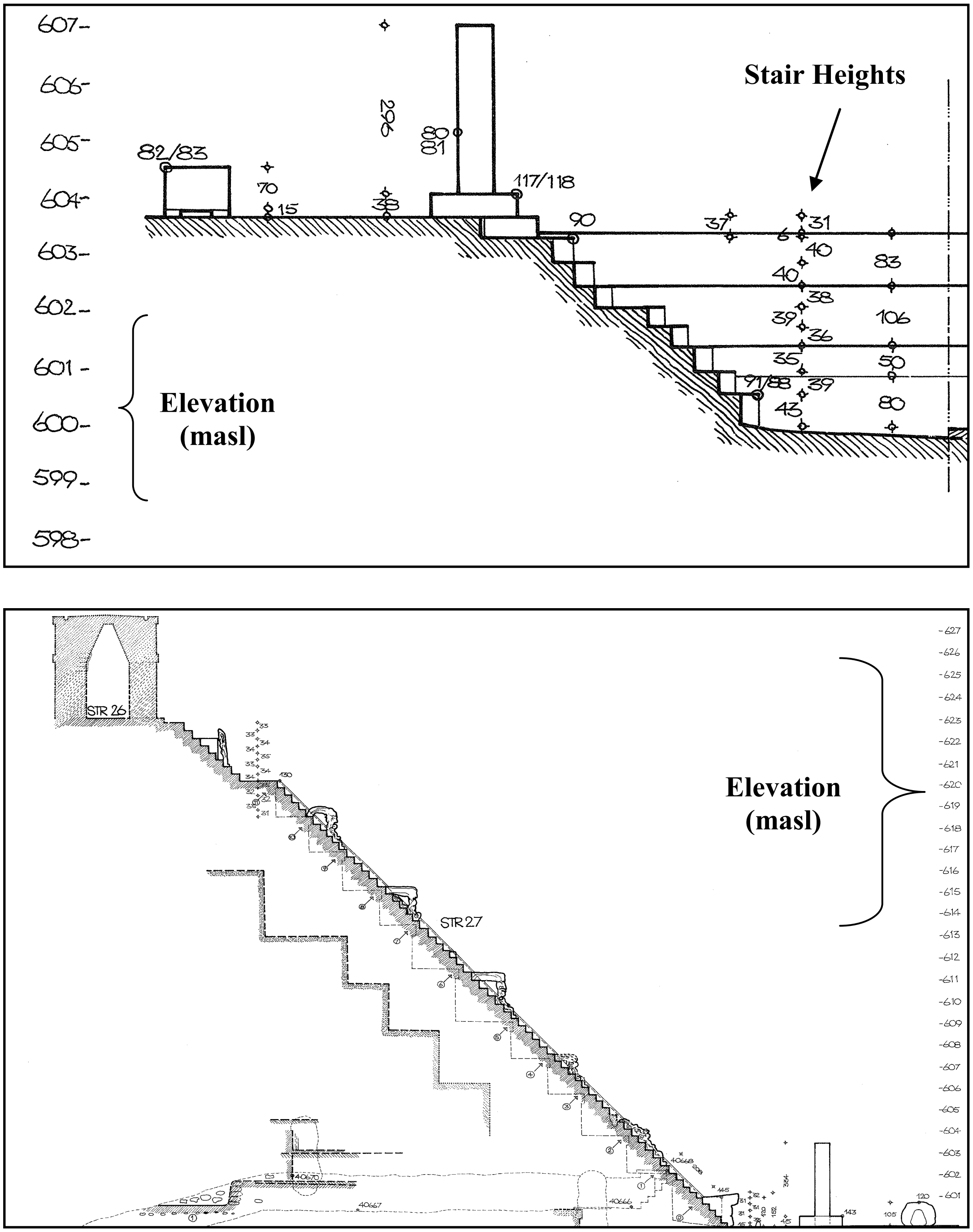


Figure 5.4: **Individual step heights for Structure 10L-10A (top) and periodic stairway elevations for Structure 10L-26 (bottom). (Drawings from Hohmann and Vogrin 1982)**

Attributing Structures Outside of the Principal Group

In attributing structures outside of the Principal Group, Group ID (e.g., Group 9N-8), Structure ID (e.g., Structure 9N-83), and Site Type (1−4) were available from survey or excavation data. These designations were assigned manually to each feature in the *structures* shapefile. However, in attributing heights I needed to employ two different methods, depending on whether or not a site had been excavated. In the excavated examples, I was able to acquire platform and structure heights, and thus assigned these data directly to structures. An alternative strategy was required for unexcavated structures with unknown sites.

Using the criteria (attributes) from the Harvard Typology, I developed a method for reconstructing heights for unexcavated structures. This method does not claim to provide exact heights, but it does offer an empirical approach to the problem. The Harvard Typology classifies site types according to number of mounds, mound height, and construction materials. (Table 5.1 lists the properties of site types 1−4.) I chose to make use of the existing typology for two reasons. First, since all of the buildings in the *structures* shapefile were coded as a site type 1, 2, 3, or 4, I was able to use the GIS to semi-automate the process of calculating heights. Given Copán's 3,000 plus structures, using the GIS made calculating heights a more feasible task. Second, the typology provides data on construction materials and building form, both of which limit roof pitch and height. These characteristics were translated into information affecting platform and structure height and incorporated into a trigonometric function used to calculate overall structure height. Mound heights were not used to assign heights to Copán's structures because of varying processes and rates of structural collapse, as well as possible removal and reuse of architectural materials.

Table 5.1*: Criteria used in the Harvard Site Typology for Copán (modified from Leventhal 1979)*

Site Type	Number of Mounds	Mound Height (max)	Construction Materials
1	3-5 mounds	0.25–1.25 m	earth fill, small to medium-sized, undressed stone rubble
2	6-8 mounds	2.5–3.0 m	some surface stone, but most undressed
3	6-8 mounds	4.75 m	some surface stone, but most undressed
4	complex groupings with multiple plazas	10 m	large stones, both rough and dressed, often have vault stones

Before establishing specific criteria for the methodology, I carried out a literature search looking for information on how architectural construction affects height, data on excavated structures and ethnographic examples of modern Maya houses (e.g., Ahlfeldt 2004; W. Fash 1989; Hendon 1987; Maca 2002; Wauchope 1938). From this search, I determined that four variables needed to be accounted for in reconstructing structure heights: (1) wall thickness, (2) wall height, (3) roof pitch (angle), and (4) platform height. The values of these variables are dependent upon construction materials and site type. I carried out a second literature search to determine the average value of each variable for Copán's four site types. Ultimately, a trigonometric formula was used to reconstruct overall structure height from the average values of these four variables and building footprints (see Appendix B for a list of sources and individual data values.) Table 5.2 lists the final results of this search.

Table 5.2*: Variables used in calculating unknown structure heights*

Site Type	Wall Thickness	Wall Height	Roof Pitch	Platform Height
Type 1	N/A	2.0 meters	45°	N/A
Type 2	N/A	2.0 meters	45°	0.54 meters
Type 3	N/A	2.0 meters	45°	0.97 meters
Type 4	2.0	2.0 meters	60°	1.15 meters

The following section summarizes how the values for each of the variables listed in Table 5.2 were determined. The differences in values for Copán's four site types are due, in part, to the different techniques and materials used in their construction. They are also a result of differing economic resources available to people living at these sites.

Excavations of type 1 sites, believed to have been inhabited by the poorest of Copán's commoners, indicate that structure walls were constructed of thatch and finished with a coating of adobe, and that roofs were also made of thatch (Freter 1994). In engineering terms this means that wall thickness has minimal to no effect on the height of these buildings. Information on modern Maya houses of similar materials and construction suggests that wall height averages between 1.45 and 2.39 meters; an average of 2.0 meters was used (Wauchope 1938). A survey of contemporary thatch roofs in the Maya region indicates that their pitch ranges from 42° to 60° (Wauchope 1938). According to the available information, variability in roof pitch depends on two factors: (1) availability of construction materials and (2) likelihood of major tropical storms or hurricanes. In areas with fewer resources (thatching materials), the roof pitch is steeper, that is, closer to 45°. Given that wood resources are believed to have been quite limited at the end of the Late Classic period in the Copán Valley (due in large part to a population boom requiring wood for construction of houses, production of plaster, cooking, and more), all of the thatch-roofed houses are believed to have had a pitch close to 45°. This includes all structures located in type 1 sites. Excavations and surveys at Copán show that type 1 structures had foundations made of uncut stones and were not elevated; therefore, platform height is not applicable.

As at type 1 sites, structures at type 2 sites were constructed of thatch with adobe-finished walls. This means, again, that wall thickness did not affect structure height, wall height averaged 2.0 meters, and roof pitch is estimated at 45°. The major difference is that structures at type 2 sites were built atop platforms (and consisted of a greater number of mounds). The literature survey indicated that the average platform height for type 2 structures was 0.54 meters (see Appendix B for list of individual values and corresponding structures for site types 1−4).

Structures at type 3 sites were built using somewhat different materials and techniques than those found at type 1 and 2 sites, because they were occupied by elite rather than commoners. Although structure walls were constructed of stone rather than thatch, wall thickness still does not affect structure height because the roofs are made of thatch, which means that walls do not have to be constructed to be weight-bearing. The wall height is averaged at 2.0 meters and the thatch-roofed construction means that the roof pitch is estimated at 45°. At Copán, the average platform height was 0.97 meters.

Structures found at type 4 sites are believed to have been occupied by Copán's wealthiest elite and thus were constructed of the finest materials. The walls are built of cut stones, many of which are dressed, and the roofs are also constructed of stone. The ancient Maya used vault stones and thick walls to support the heavy stone roofs. Excavation data from Copán indicate that many of these weight-bearing walls were at least 2.0 meters wide in order to support the load of the roof. The stone construction also affected roof pitch. Architectural reconstructions of type 4 buildings indicate that the roof pitch (in this case the pitch of the vault stones; the actual roof was flat) approximated 60° (Jennifer von Schwerin, personal communication 2007; W. Fash 1989). Finally, average platform height was 1.15 meters.

These four variables—wall thickness, wall height, roof pitch, and platform height—provide useful information for reconstructing structure heights; however, there is one additional variable that is fundamental to calculating structure height: structure width. This variable is derived from a structure's floor plan dimensions. Figure 5.5 illustrates how a basic trigonometric function was modified using the variables listed in Table 5.2 to estimate the heights of unexcavated structures at Copán.

The basic formula is:

$$\tan t = \frac{\text{opposite}}{\text{adjacent}} \quad \text{or} \quad \tan t = \frac{y}{x}$$

To solve for ***y***, roof height, it is necessary to know ***t***, angle of roof pitch, and ***x***, building width. Using the data from Table 5.2 and data on building widths embedded in the GIS, this formula was used to reconstruct the heights of unexcavated buildings at Copán. Figure 5.6 lists and describes the formulas that were derived for each of Copán's four site types. The final formulas are as follows:

Type 1 Sites

$$\text{height} = ([0.5 \times x] \times \tan 45°) + 2.0$$

Type 2 Sites

$$\text{height} = ([0.5 \times x] \times \tan 45°) + 2.54$$

Type 3 Sites

$$\text{height} = ([0.5 \times x] \times \tan 45°) + 2.97$$

Type 4 Sites

$$\text{height} = ([0.5 \times x] \times \tan 60°) + 1.15$$

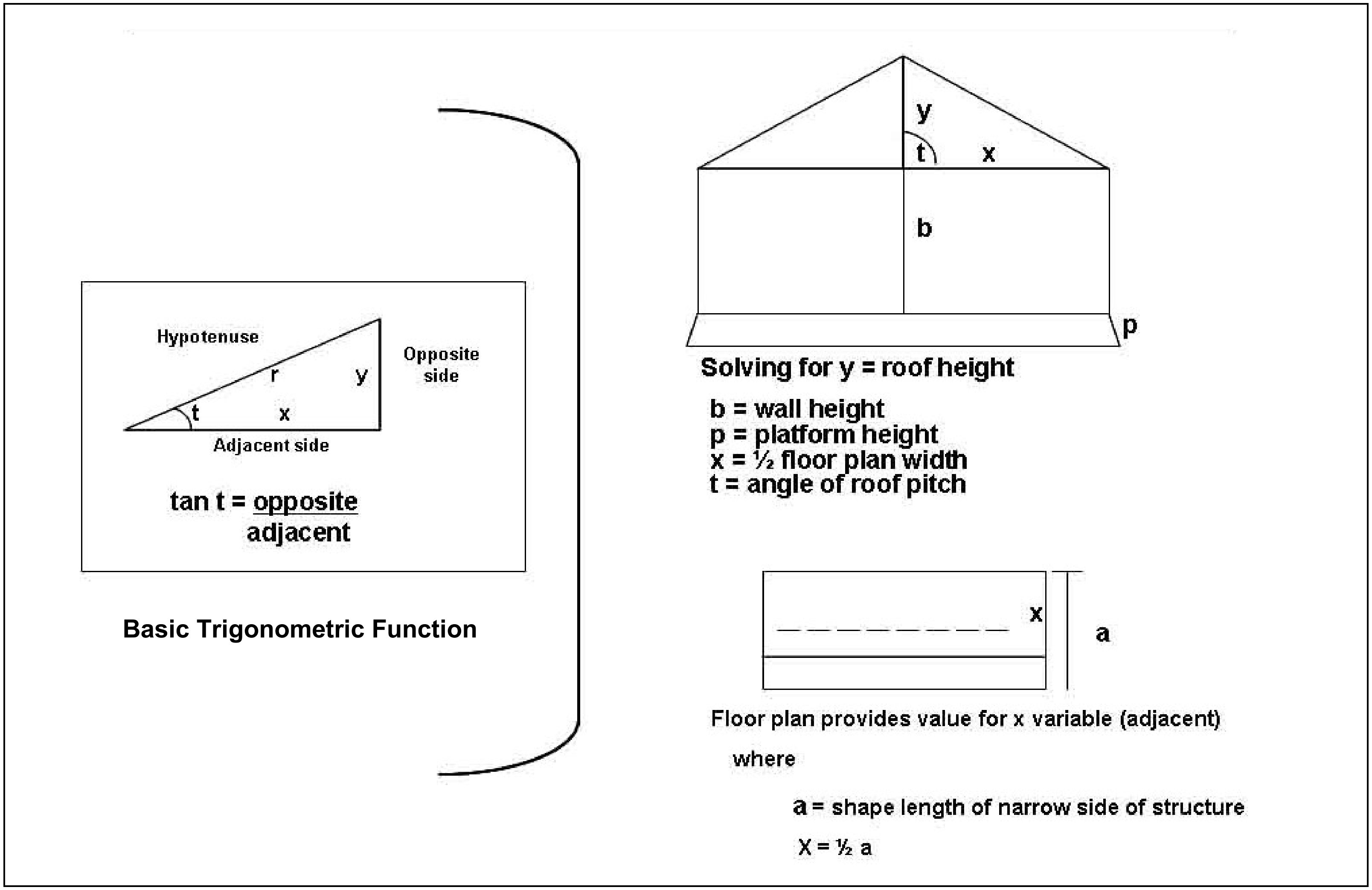


Figure 5.5: **Modifying basic trigonometric formula to calculate structure heights**

Type 1

$$\text{height} = ((0.5 * \text{shape length}) * \tan t) + b$$

where b = wall height
$\tan t = 45°$

$$\text{height} = ((0.5 * \text{shape length}) * 1) + 2.0$$
$$= (0.5 * \text{shape length}) + 2.0$$

Type 2

$$\text{height} = ((0.5 * \text{shape length}) * \tan t) + b + p$$

where b = wall height
$\tan t = 45°$
p = platform height

$$\text{height} = ((0.5 * \text{shape length}) * 1) + 2.0 + 0.54$$
$$= (0.5 * \text{shape length}) + 2.0 + 0.54$$

Type 3

$$\text{height} = ((0.5 * \text{shape length}) * \tan t) + b + p$$

where b = wall height
$\tan t = 45°$
p = platform height

$$\text{height} = ((0.5 * \text{shape length}) * 1) + 2.0 + 0.97$$
$$= (0.5 * \text{shape length}) + 2.0 + 0.97$$

Type 4

$$\text{height} = ((0.5 * \text{shape length}) * \tan t) + b + p - w$$

where b = wall height
$\tan t = 60°$
p = platform height
w = wall thickness

$$\text{height} = ((0.5 * \text{shape length}) * 1.73) + 2.0 + 1.15 - 2.0$$

Figure 5.6: **Trigonometric formulas derived to calculate unknown structure heights based on site type at Copán**

Before these formulas could be used in the GIS to calculate roof height, I first needed to calculate one-half of *x,* or building width. This required multiplying all structure widths by 0.5 and populating a new field in the *structures* attribute table with the new values. After this process was completed, I took advantage of the GIS capabilities and used the *ArcMap* Field Calculator to calculate building heights for each of Copán's four site types (Figure 5.7 shows the formula for type 4 sites).

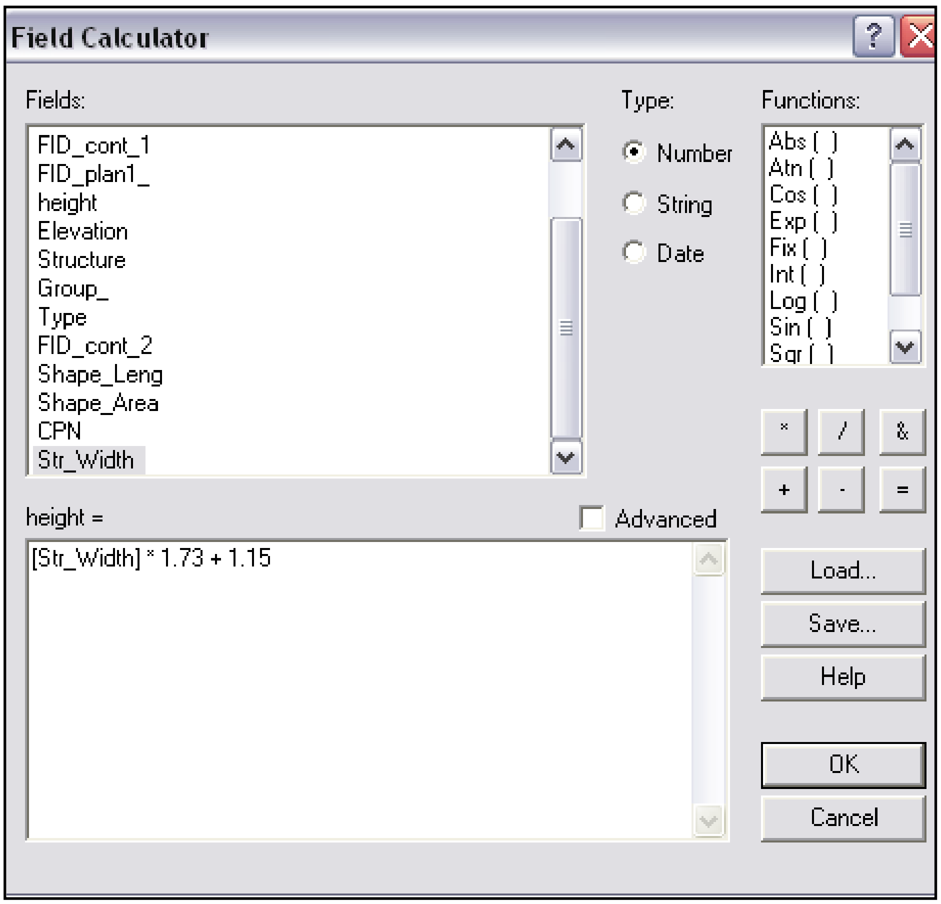


Figure 5.7: **Using field calculator in ArcGIS 9.1 to calculate heights of structures at type 4 sites**

After all structure heights were calculated, the GIS shapefiles were ready for the next step in preparing the data for the access (integration) and visibility analyses. Because shapefiles consist of discrete objects they do not provide a continuous surface, and a continuous surface was necessary to calculate the integration values and fields-of-view needed to address the main question of this dissertation research (that is, whether Copán's spatial configuration mirrored and consequently shaped its social hierarchy). Therefore the shapefiles, or vector data, had to be converted to raster files.

Converting Shapefiles to Raster Files

Most access and visibility studies done in the Maya region have been based on discrete data (individual objects) occupying a two-dimensional plane (e.g., Sanchez 1997; Stuardo 2003; Vogrin 1989). These studies have shown that access and visibility were important to the ancient Maya; however, they have two major shortcomings. First, access studies have not included any three-dimensional data and so they do not take into account the effect building and wall heights and topography have on access. Second, visibility studies (excepting those of Hammond and Tourtellot 1999 and Tourtellot et al. 1999), used line-of-sight between discrete objects rather than a 360° field-of-view, which more closely approximates the human visual experience. In this research, I have overcome these two limitations by using GIS to create raster surfaces that contain continuous data, consisting of *z*-values that take into account topography and the heights of ancient cultural features.

A raster dataset is a rectangular matrix of cells, or pixels. Each cell has a value that represents a particular attribute. In this research, these values are derived from the attributes of height or elevation. The advantage of a raster dataset is that it forms a continuous surface on which to carry out GIS modeling and three-dimensional visualization. The ultimate goal of this step in the methodology is to create two surfaces, an Urban-View Digital Elevation Model (DEM) and an Urban-Access DEM, that combine data from multiple shapefiles into two continuous surfaces from which measurements of access and visibility are made. To achieve this goal, I employed two different techniques to convert shapefiles (vector data) into raster data. The technique used depended on whether the shapefile being converted contained lines or polygons. Four shapefiles were used in this process, three of which had polygons (*structures, hydrology,* and *sacbeob*) and the fourth shapefile (*contour lines*) did not have polygons.

Creating the Urban-View DEM for the Visibility Analysis

The Urban-View DEM was composed of elevation and height data from the *contour lines, structures*, and *sacbeob* shapefiles and was generated to provide a dataset to carry out the visibility analysis. Before converting the polygon shapefiles to raster data, I used the UNION function to geometrically intersect the features from the *structures* and *sacbeob* shapefiles to create a single shapefile. Once these shapefiles were combined, I used the *convert features to raster* tool on the Spatial Analyst Toolbar in ArcGIS to directly transfer the attribute of height to the resultant *infrastructure* raster dataset. Areas without archaeological features were assigned a value = 0. The pixel output cell size was set at 20 centimeters to maintain very high resolution data without overwhelming the computer hardware's processing capabilities. Figure 5.8 juxtaposes the Principal Group shapefile with the resultant raster dataset.

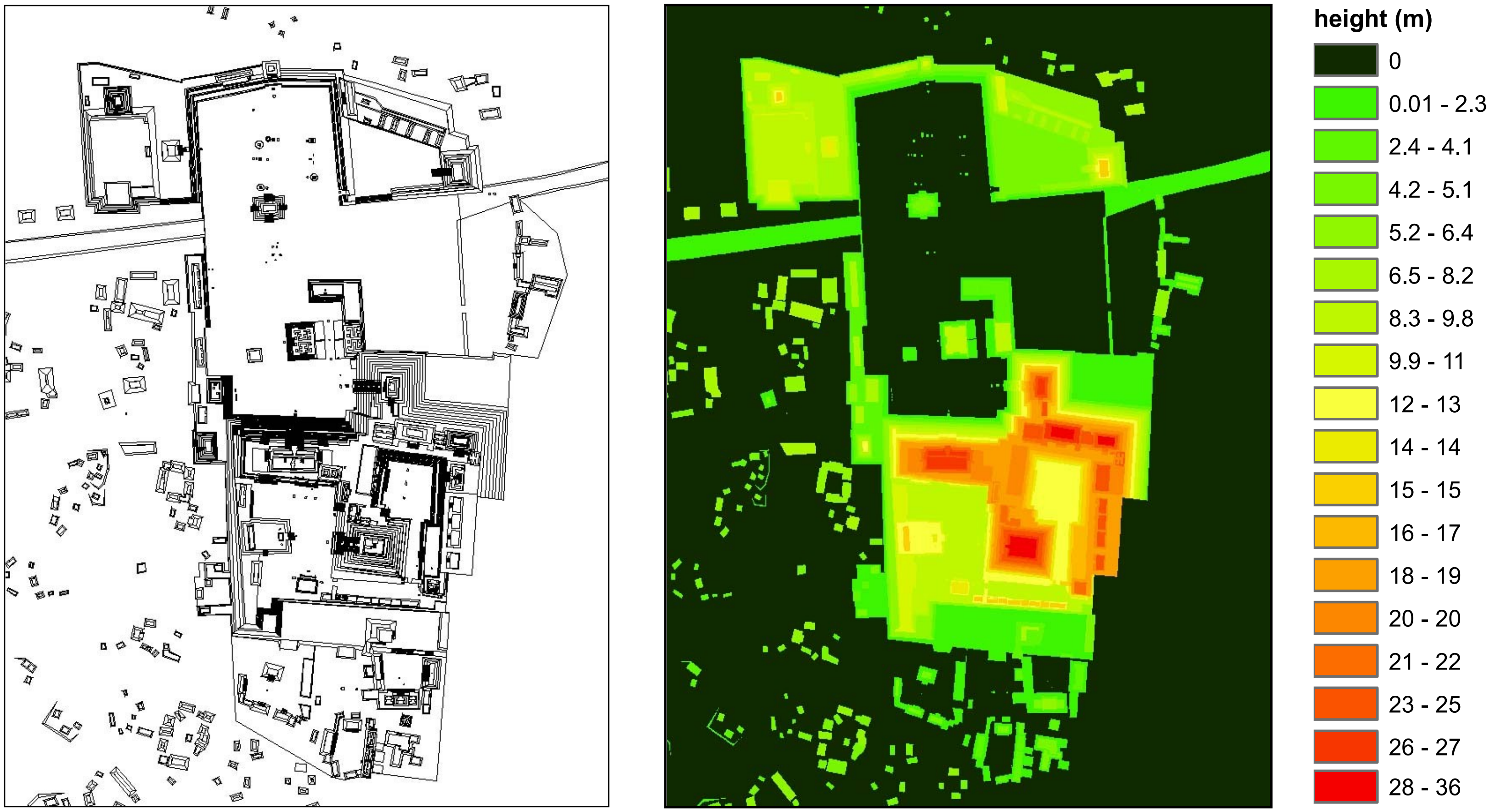


Figure 5.8: **Juxtaposition of shapefile with resultant raster dataset**

The *Topo to Raster* tool in ArcGIS was used to convert the *contour lines* shapefile into a Digital Terrain Model (DTM). Unlike polygons, lines do not carry an area attribute, and therefore values for the spaces between lines must be interpolated. This was done through spatial interpolation, which is a process of calculating unknown values from a set of sample points with known values that are distributed across an area. In this case, elevation values from the contour lines were used. Given that none of the elevations had a value equal to zero (i.e., no "empty" space), the resultant raster dataset was much larger than the structures and *sacbeob* raster files; the pixel output size was therefore set at 1.5 meters. Figure 5.9 compares the original contour lines with the resultant DTM.

After these two raster datasets were generated, they were "added" together to create a single surface, the URBAN-VIEW DEM. Map Algebra is a set of commands (a computer language) that provides tools to perform operations such as addition, subtraction, multiplication, and more. In this case, the *Infrastructure* raster file and the DTM were added together to create the URBAN-VIEW DEM (Figure 5.10). To carry out this process, the Infrastructure file had to be resampled to the same resolution as the DTM, 1.5 meters. After this step was completed, structure heights were added to the valley's natural elevation to create a surface on which viewsheds were ultimately generated for the visibility analysis in this dissertation.

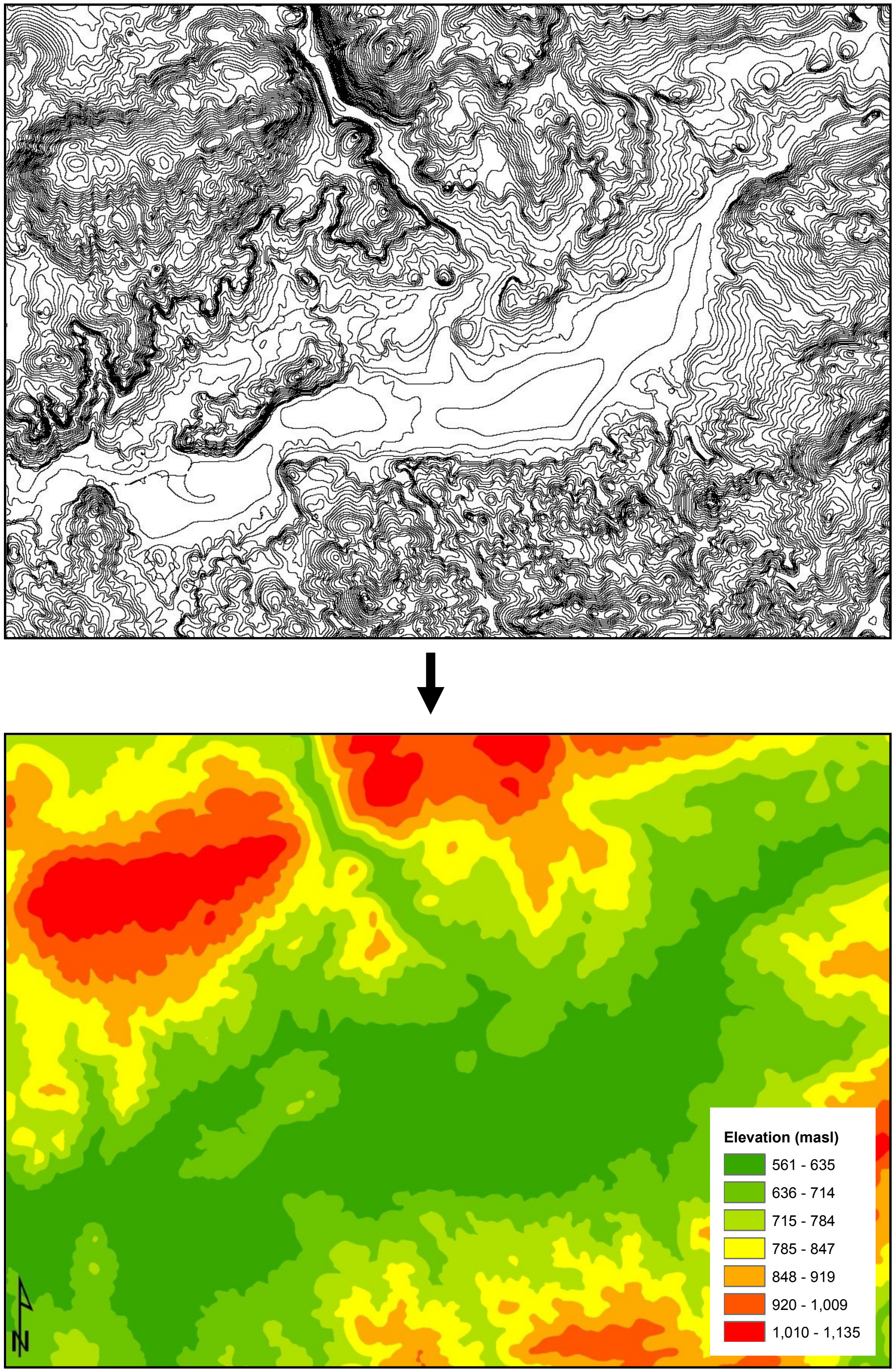


Figure 5.9: **Conversion of contour lines into Digital Terrain Model (DTM)**

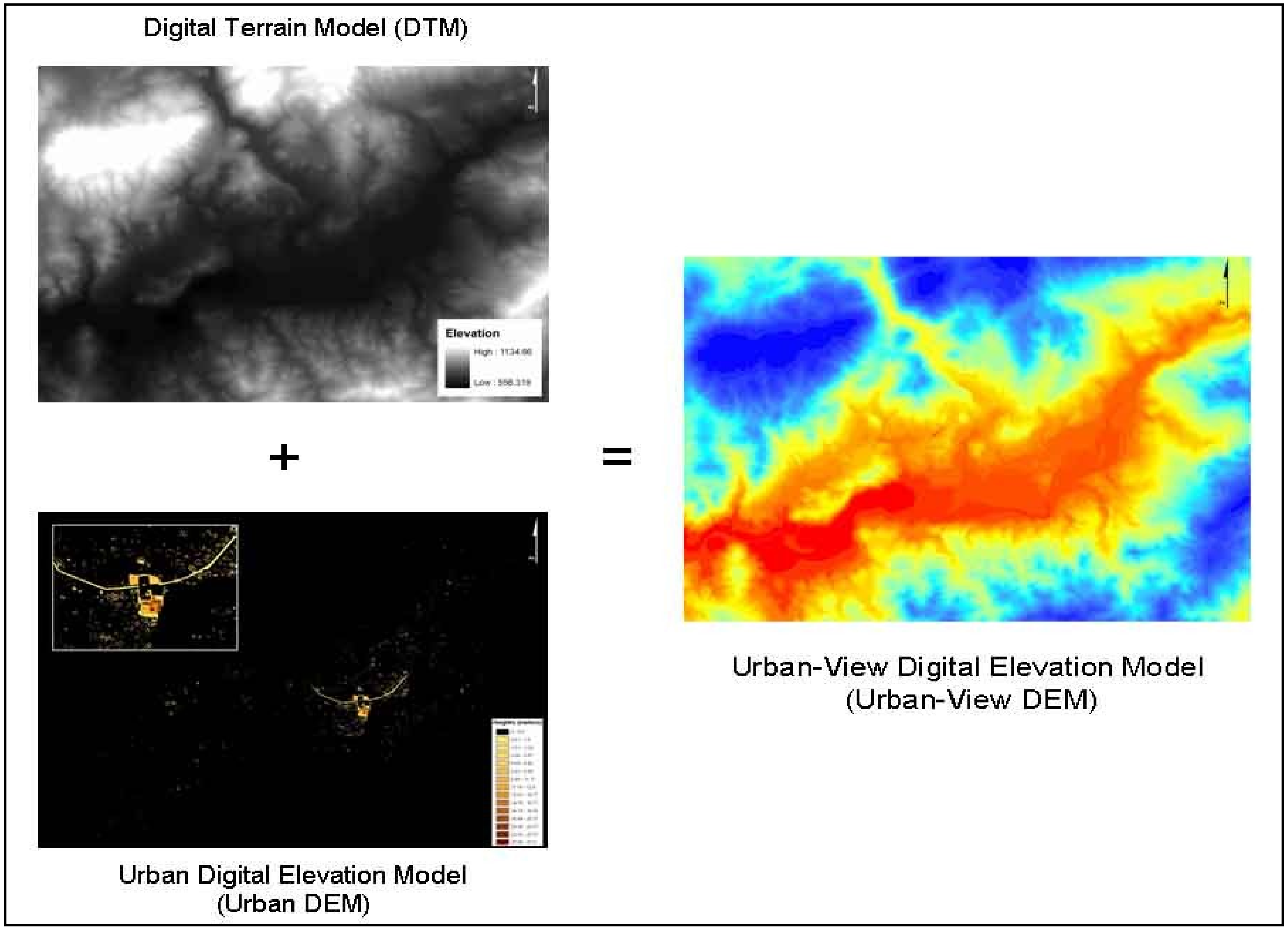


Figure 5.10: **Map Algebra adding the Digital Terrain Model (DTM) and infrastructure files to create the Urban-View Digital Elevation Model (DEM)**

Creating the FRICTION Surface for the Access Analysis

The next step in the methodology was to create a FRICTION Surface to take into account impedance (friction), or cost of movement. Initially, I combined the newly generated *structures/sacbeob* shapefile with the *hydrology* shapefile. The UNION function in ArcGIS was used to carry out this process. Then I reclassified the structures, causeway, and hydrology features in this new shapefile into three classes: (1) facilitators, (2) barriers, and (3) no change. The *sacbeob* were classified as facilitators, as they are seen to attract and smooth the progress of pedestrian movement, and assigned a value = 0.9. The Río Copán and the Quebrada Sesesmil were classified as barriers, or as features that would increase the cost of movement, and therefore were assigned a value of 3. The reservoirs and the structures were classified as barriers and assigned a value of 999 to ensure that they would not be crossed. Spaces without archaeological features or hydrological features were classified as areas of no change and were assigned a value of 1. Then I converted this reclassified shapefile to a raster surface called a FRICTION Surface. Ultimately this FRICTION Surface was combined with the URBAN-VIEW DEM to carry out the integration (access) analysis component of this dissertation research.

Access (Integration) Analysis

Most archaeologists interested in quantifying the effects of access on social interaction employ the quantitative access analysis techniques of space syntax (Bustard 1996; Ferguson 1996; Hillier 1999; Hillier and Hanson 1984; Shapiro 2005; Stuardo 2003). Such investigations have provided insight into ancient social interaction, but because they measure integration (degree of connectivity between spaces) using two-dimensional planimetric maps, they cannot account for cost of movement (Figure 5.11). Again, the ability of GIS to move beyond two-dimensional maps to generate three-dimensional datasets provides a way to resolve the difficulty.

In a recent issue of *Environment and Planning B: Planning and Design* (2005, Vol. 32, No. 4), Carlo Ratti explores how the urban digital elevation model (DEM)—a raster map that stores building heights—can serve as a better alternative to the axial maps typically used in space syntax. Ratti (2005:547) writes of axial maps,

> Although a simplified format and a concise representation of street networks would probably have been a necessity in the early days of space syntax, when computing resources were scarce, it is possible today that a more complete analysis based on a richer support would be helpful to understand the "social logic of space."

By "a more complete analysis" he means methods that account for three-dimensionality using the urban DEM, which stores 3D information using a 2D matrix of elevation values. Ratti finds no fault with the key concepts of space syntax itself, but rather with the way these concepts are traditionally measured. In fact, he believes that the concept of a measure of integration whose values can be correlated to the potential for movement *through* or *to* particular spaces is fundamental to understanding the influence of urban configurations on the use of space by pedestrians. However, rather than measuring integration using two-dimensional axial graphs based on topological distance (number of turns in the lines of sight), he suggests an alternative approach to calculate integration using urban DEMs based on Euclidean distance.

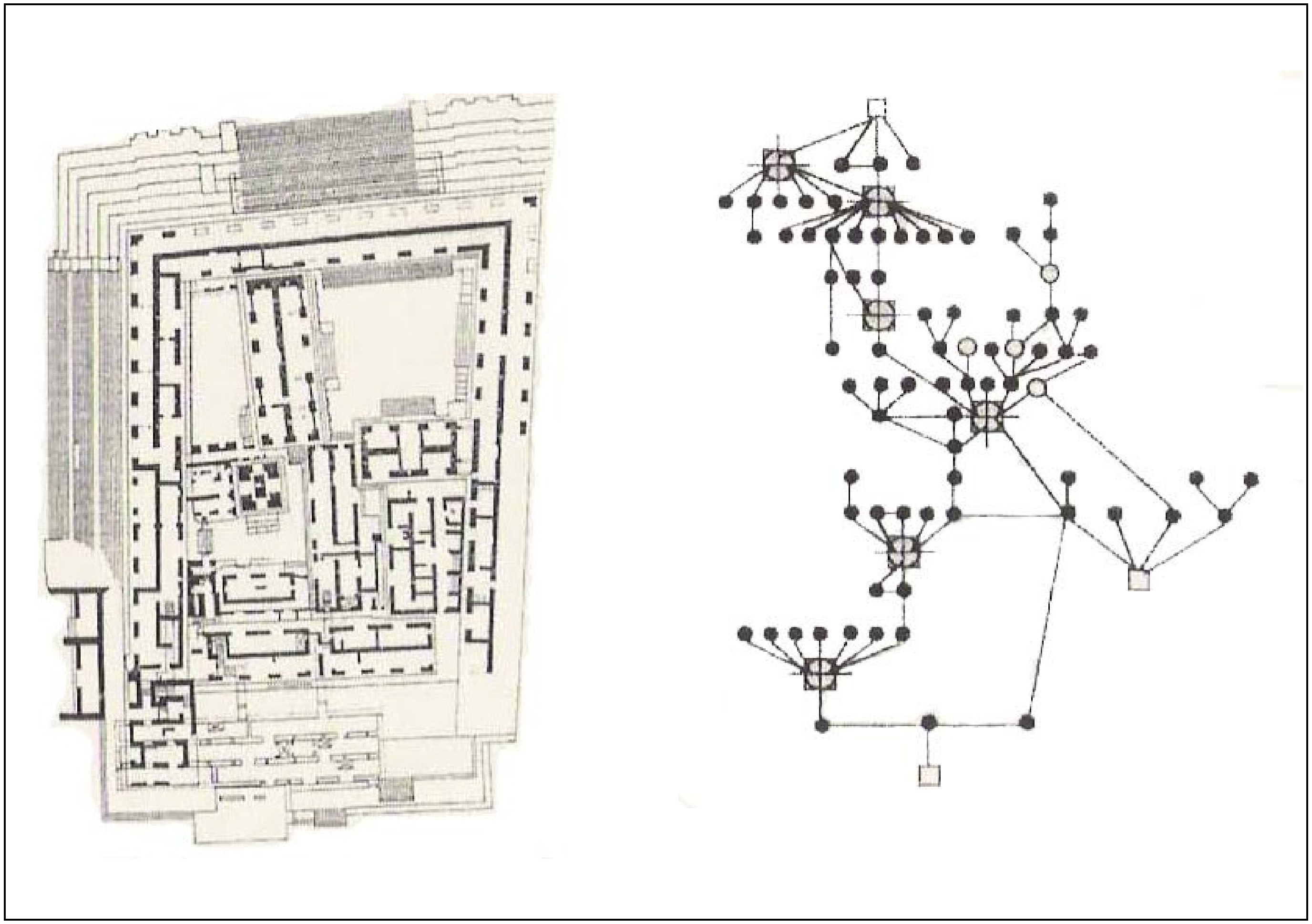


Figure 5.11: E**xample of longest-line-of-sight mapping of ancient Maya palace at Palenque, Mexico (modified from Stuardo 2003)**

He suggests measuring the integration, or connectivity, of particular locations (or certain points in space) by taking the average length of the journeys to travel from a given location to all other points, and repeating the process for different origins (Ratti 2005). Locations with higher average lengths are less integrated (less accessible with respect to the system as a whole), and those with lower average lengths are more integrated (more accessible). This approach is based on straight-line measurements (that is, as the crow flies) and is the simplest way to measure integration using this alternative methodology, but it is not the only way. Instead, a cost-of-passage function, also called friction or impedance, can be employed to more closely represent travel costs. Using the FRICTION Surface and Urban-View DEM, least-cost paths rather than straight-line measurements were generated to calculate integration values.

Least-cost paths are not necessarily the shortest or quickest routes, but routes that involve the least expenditure of energy. In a GIS, a cost-of-passage function is employed to calculate the accumulated cost of moving from a source or set of sources to a destination or set of destinations. The path with the lowest value, or cost, is highlighted as the least-cost travel route. In this dissertation research, least-cost paths were generated from 74 sample sites (or origins) representing the range of site types 1−5 (see Appendix C for list of sites). These sample sites consist of 70 residential sites distributed across the valley and four locations in the Principal Group: the Great Plaza, West Court, East Court, and Royal Courtyard. For each of these 74 sites, least-cost paths were generated to the rest of Copán's 3,000+ sites (destinations), which were classified according to site type. By separating the destinations by site type, the range of variation in path costs for each site type could be documented, ultimately allowing for a statistical test based on an analysis of variance. This analysis of variance allows us to evaluate integration values for Copán's site types, letting us know us whether or not significant differences in accessibility exist between site types. Given that these site types are believed to have been occupied by different groups of people in Copán's social hierarchy, the presence or absence of significant differences between site types addresses one of the main questions in this dissertation: *Was Copán configured to make certain groups of people more integrated and others more segregated?*

However, before statistical testing, additional data creation and processing needed to be created in the Copán GIS. First, the city's architectural groups were organized according to site type in the attribute table of the *structures* shapefile, and then the data was exported to create four new shapefiles*: type 1, type 2, type 3,* and *type 4*. Second, another set of four shapefiles (*type 1 destinations, type 2 destinations, type 3 destinations, type 4 destinations*) comprising points representing the center point of each architectural group were created. Third, the 74 sample sites were randomly selected across Copán and exported as 74 separate shapefiles. Before these new shapefiles could be used to create least-cost paths, two new raster surfaces needed to be generated: one based on slope and the other on aspect.

Both the slope and aspect surfaces were derived from the Urban-View DEM. First, a slope function calculating the rate of change in elevation over the distance between each cell and its eight neighbors was used in ArcGIS to generate a new surface populated with slope values (Figure 5.12). A slope surface rather than actual elevations was used to generate least-cost paths because slope surface better simulates pedestrian movement across natural terrains, as people typically follow gentle gradients rather than moving from low point to the low point. Next, the *Aspect* tool in the *3D Analyst* Toolbox in ArcGIS was used to identify the downslope direction of the maximum rate of change in value from each cell to its neighbors (ESRI Documentation Library). Values in the output surface reflected compass directions ranging from 0° to 360°. After both the new shapefiles and these two new raster surfaces were created, the *Path Distance* tool in the *Spatial Analyst* Toolbox of ArcGIS was used to generate two additional raster surfaces—a Cost Distance Surface and a Cost Direction Surface—for each of the 74 sample sites. This step was repeated until 148 new raster surfaces were generated.

The files required to generate the Cost Distance and Cost Direction Surfaces included the origin (a sample site), the FRICTION Surface, the Slope Surface, and the Aspect Surface. The FRICTION Surface (Figure 5.13) was multiplied to the Slope Surface to account for the effect of barriers and facilitators on the cost of movement. The Aspect Surface determines the horizontal cost when moving from a cell to its neighbors.

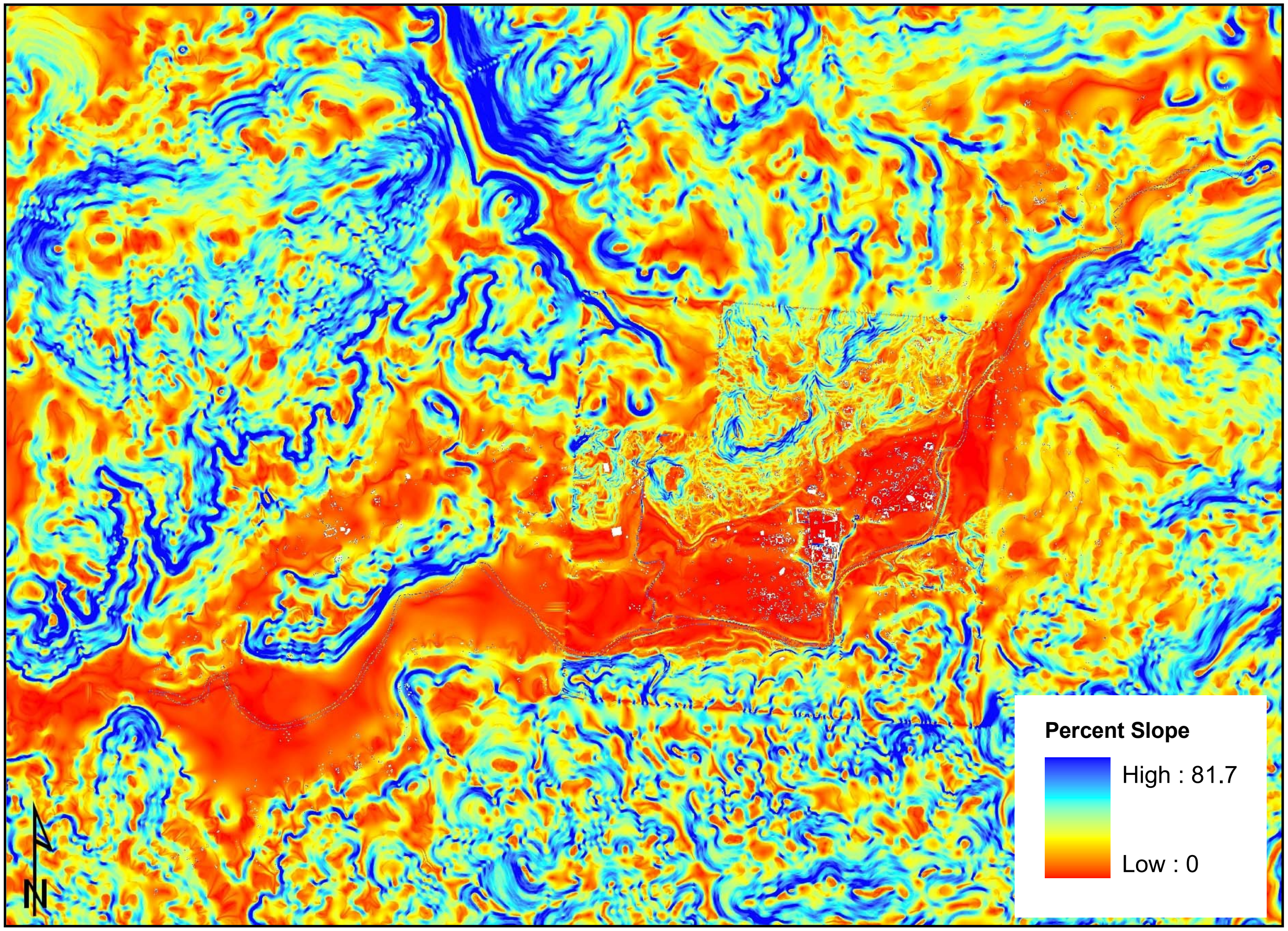


Figure 5.12: **Slope of natural topography and cultural features in Copán Valley, Honduras**

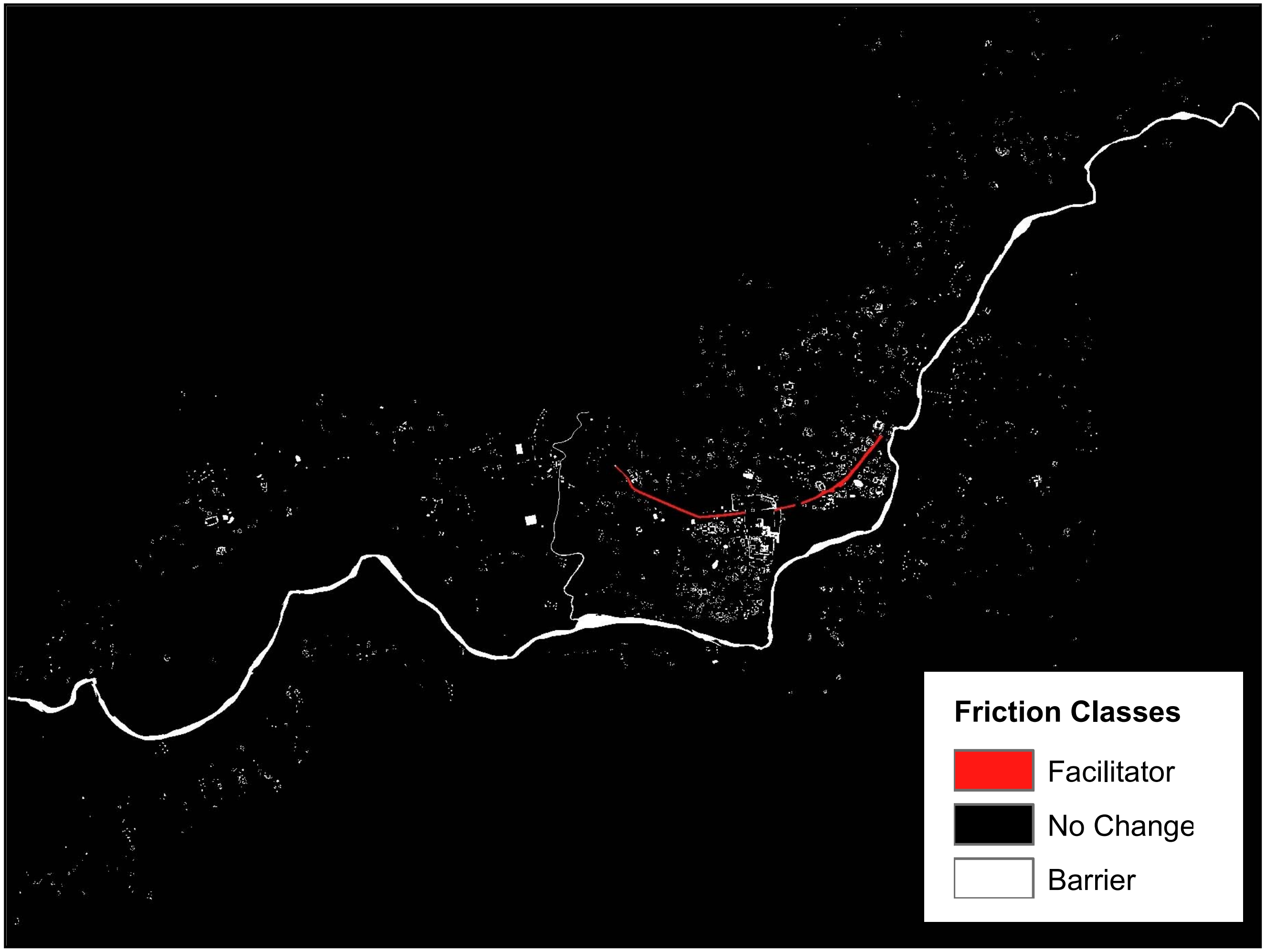


Figure 5.13: **Friction Surface illustrating barriers, facilitators, and areas of no change**

Figures 5.14 and 5.15 illustrate the Cost Distance and Cost Direction Surfaces generated for the sample site, Group 7M-8.

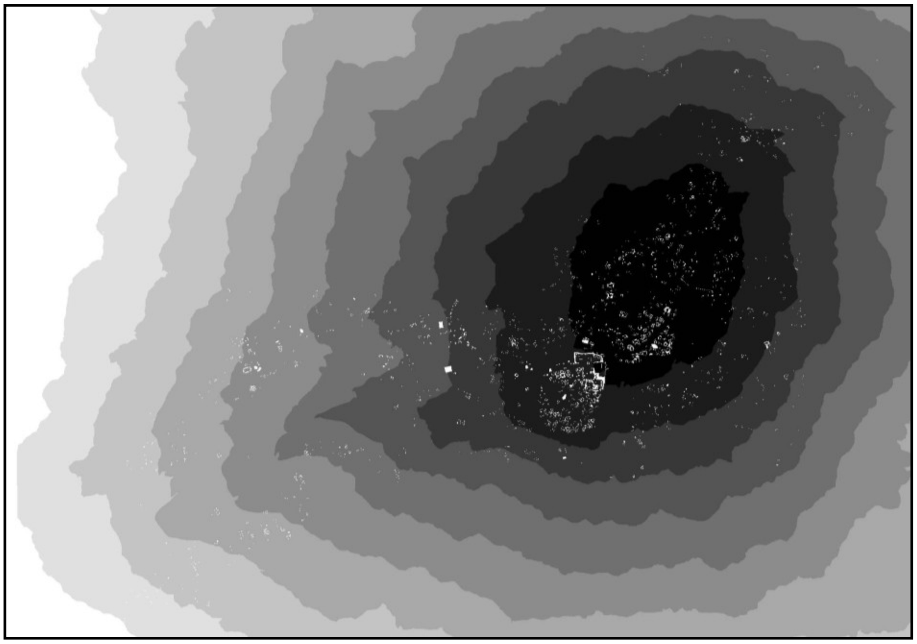


Figure 5.14: **Example of cost distance surface for Group 7M-8 (Type 2) in Chorro *sian otot***

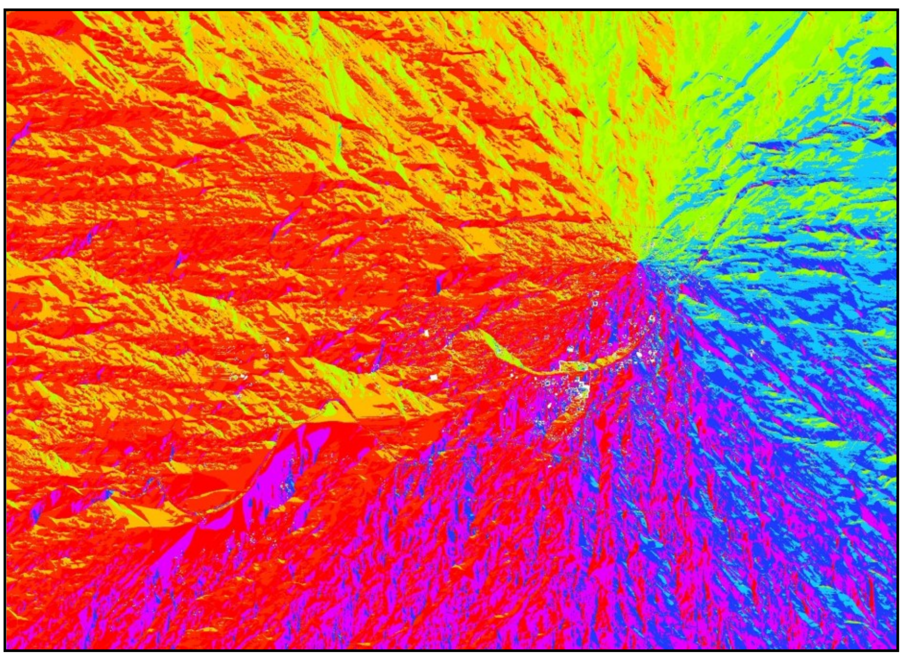


Figure 5.15: **Example of cost direction surface for Group 7M-8 (Type 2) in Chorro *sian otot***

The final step in generating least-cost paths was to use the *Cost Path* tool in the *Spatial Analyst* Toolbox to identify the least-cost paths from a sample site to all other sites (destinations) in the Copán Valley. I performed this procedure five times for each sample site in order to generate least-cost paths for Copán's five site types. Figures 5.16–5.19 illustrate the least-cost paths generated for each site type for the sample site, Group 11L-13 in El Bosque. After the least-cost paths were generated, the pathcosts (based on site type) were exported from the attribute tables to Microsoft *Excel* (see Appendix D for sample tables). In *Excel*, these data were coded for four additional attributes: (1) physiographic zone, (2) urban vs. hinterland, (3) start type (site type 1-4), and (4) *sian otot*. Ultimately, these data along with the pathcosts were imported into the statistical software package *MiniTab 15* in order to perform multi-scalar statistical tests. (See Chapter 6 for an explanation of the statistical methods and integration results.)

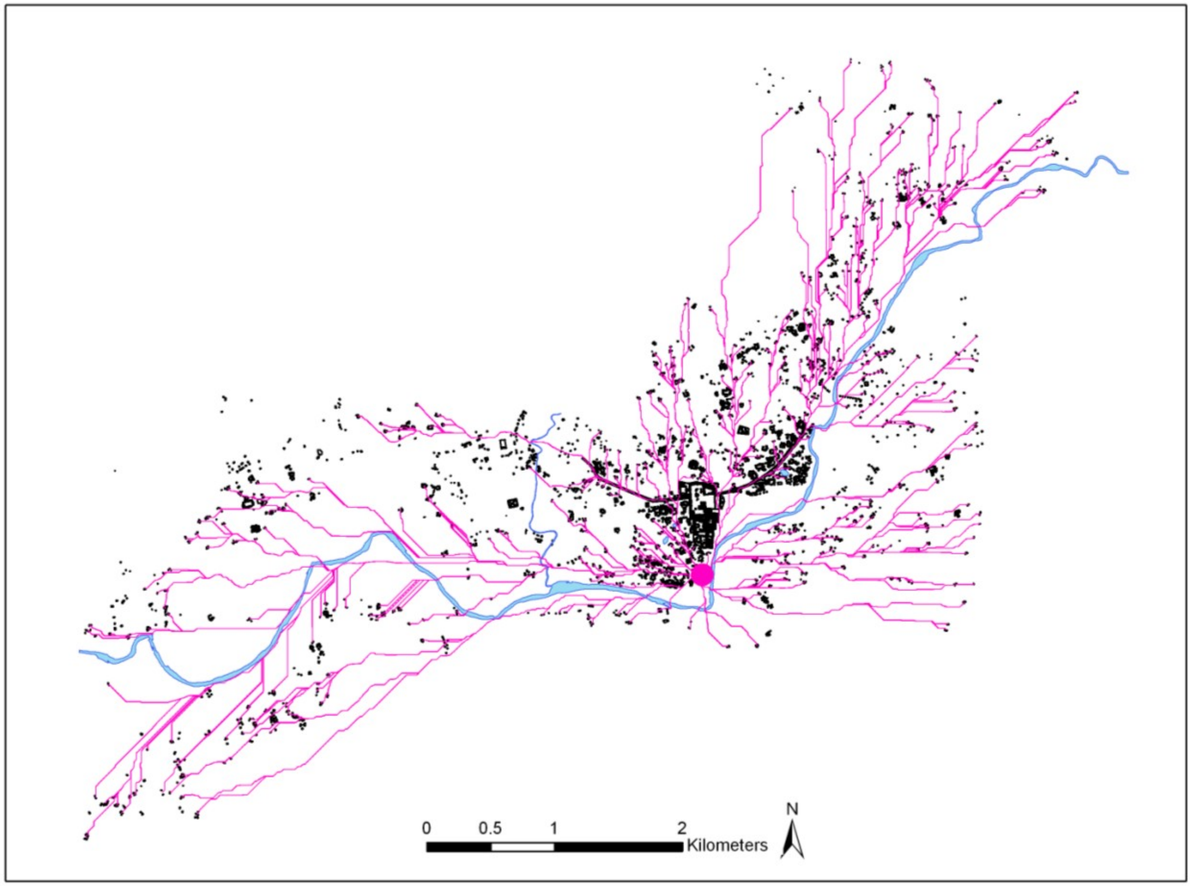


Figure 5.16: **Example of least-cost paths from Group 11L-13 to type 1 sites**

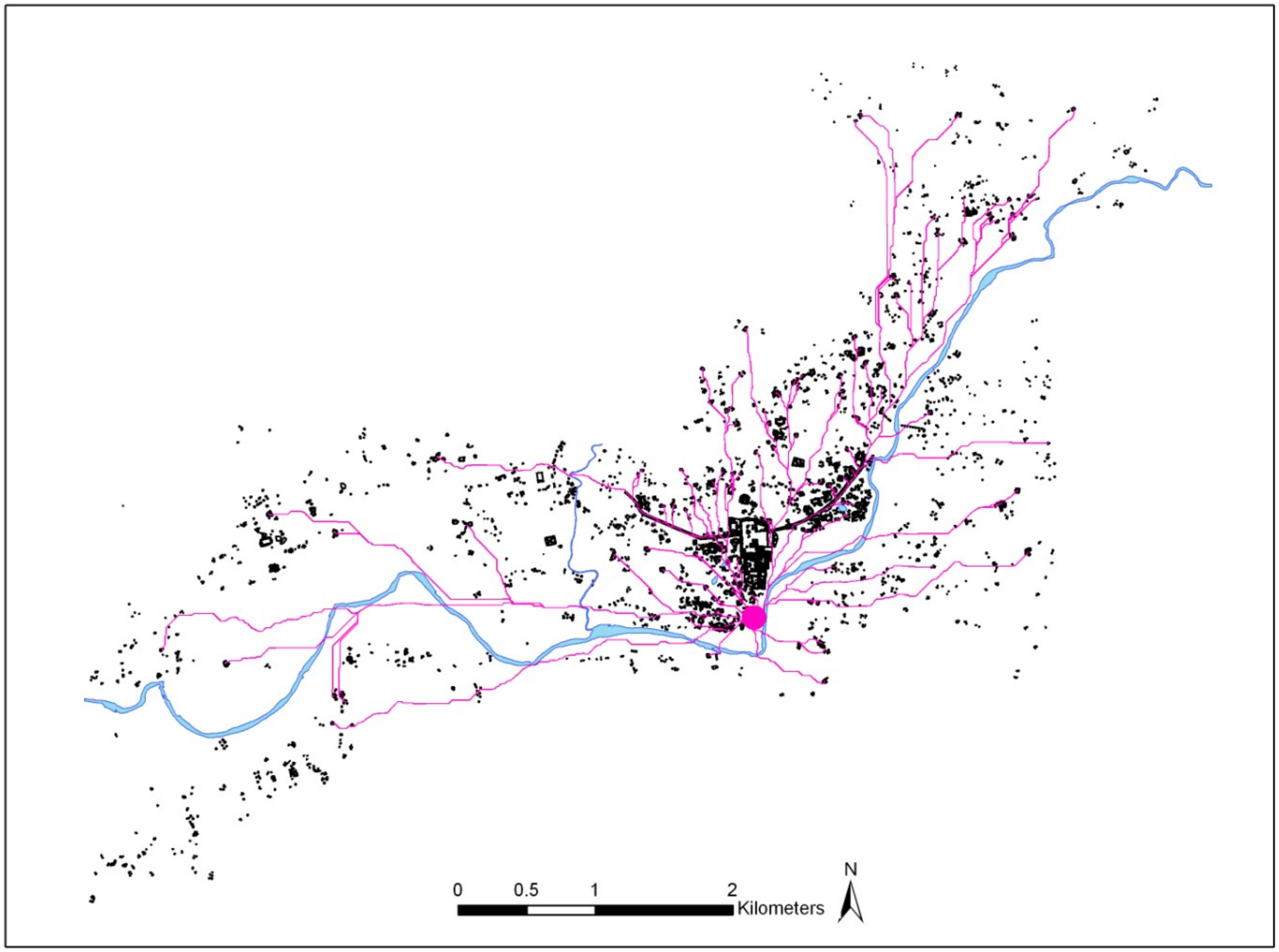


Figure 5.17: **Example of least-cost paths from Group 11L-13 to type 2 sites**

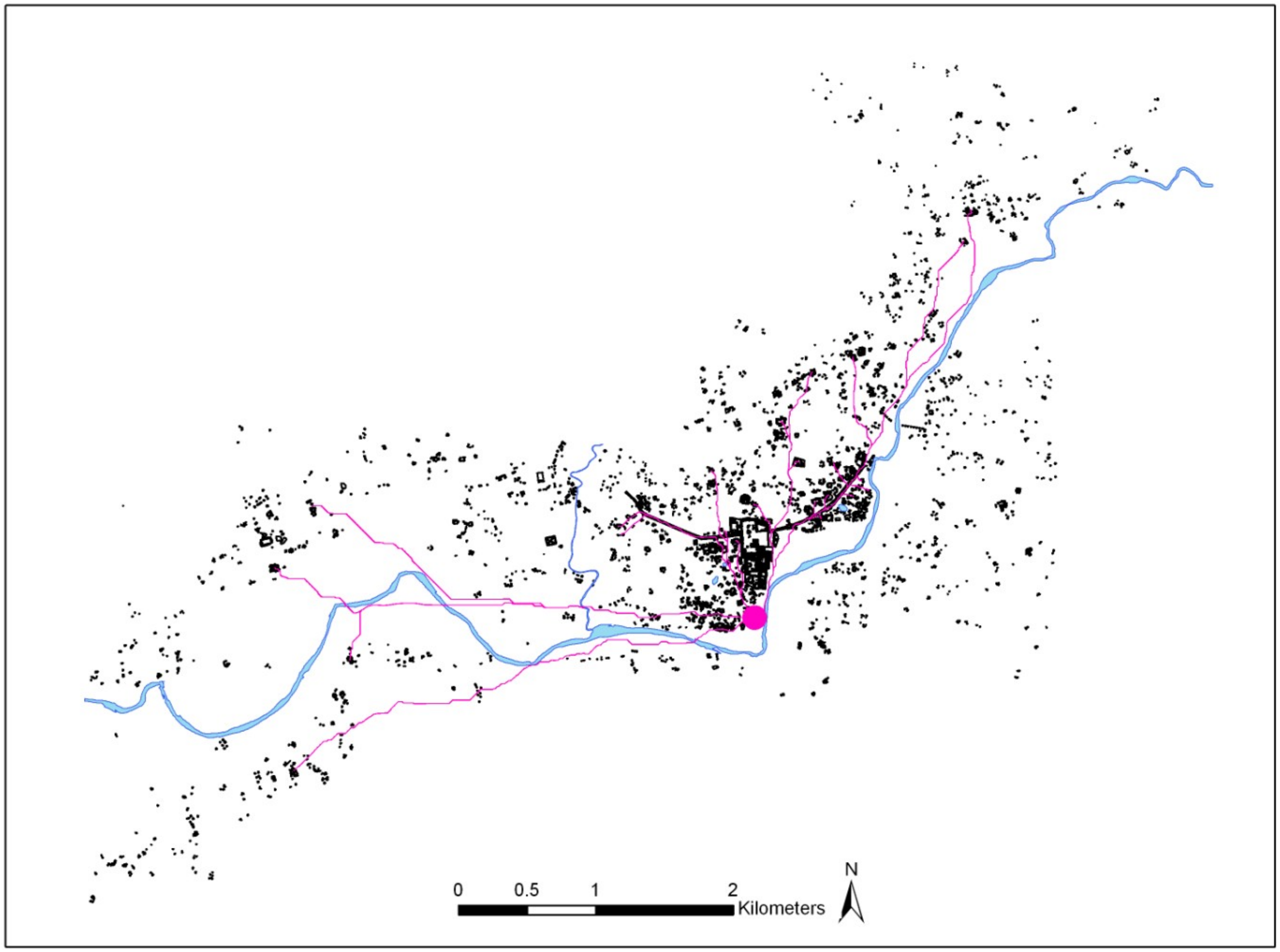


Figure 5.18: **Example of least-cost paths from Group 11L-13 to type 3 sites**

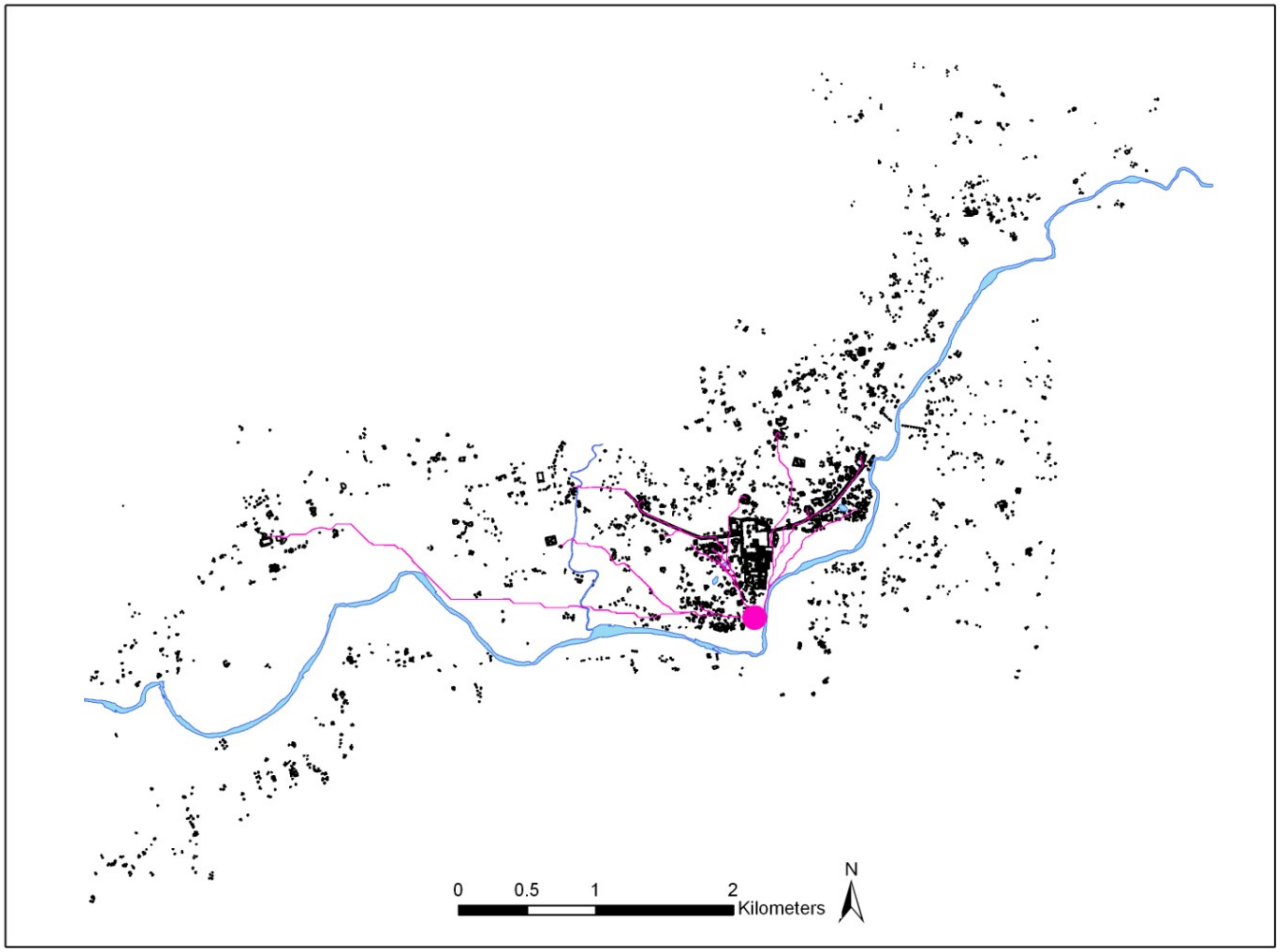


Figure 5.19: **Example of least-cost paths from Group 11L-13 to type 4 sites**

To summarize, this research uses the space syntax concept of integration to measure the potential for social interaction to take place between people living at different types of sites and in different parts of the Copán Valley. The method is based on the idea that the structure of the city influences variation in movement densities. The assumption is that integration values reflect movement rates. However, rather than using axial graphs reliant on simple 2D line-of-sight mapping to calculate integration values, an alternative method is proposed.

This innovative method uses the urban DEM, which stores 3D data such as building heights and topographic elevation, and a friction surface that stores information on barriers and facilitators, in order to more accurately represent the complexities of the ancient landscape. Integration values are calculated using a cost-of-passage function to generate least-cost paths from 74 sample sites dispersed throughout the Copán Valley. The average values of these least-cost paths indicate the likelihood that movement will occur to or through a particular space, that is, the likelihood that an individual will pass through that particular space. For example, people are more likely to walk to or through those sites with lower pathcosts than those with higher pathcosts (Hillier 1996, 1999; Hillier and Hanson 1984; Hillier et al. 1993). Importantly, this approach provides a method to quantify the degree of connectivity between spaces, which serves as a proxy for determining how integrated or segregated different groups of people (based on site type and site location) were at ancient Copán.

Visibility Analysis

While integration measures connectivity between groups on the ground, visibility measures connectivity through the sending of visual messages via topographic prominence. Spatial configurations measured through integration are the primary generators of movement patterns, and the influence of visibility is secondary (Hillier 1996; Hillier et al. 1993). Nonetheless, visibility still plays two fundamental roles in society: (1) highly visible landmarks attract people and (2) a landmark's degree of visibility affects its ability to communicate information and *to whom* the information is communicated. The *attraction* theory of pedestrian movement supports the first assumption. It states that the placement of buildings, monuments, and other cultural features in particular locations makes them either more or less visible—sometimes to certain groups of people, consequently influencing whether or not people are drawn to them and how people move about the landscape (Llobera 2000, 2001, 2003, 2006). For example, people are often drawn, many times inadvertently, to the highest peak or the tallest building, which often leads people to walk down the same paths passing through the same locations along their journeys. Thus, visibility works in conjunction with site configuration to guide pedestrian movement through landscapes.

Vision is deemed to be one of the most powerful senses, and numerous studies, both modern and archaeological, show that visibility often serves as a mechanism of cultural integration and/or segregation through its ability to communicate information (e.g., Crown and Kohler 1994; Fletcher 1981; Hammond and Tourtellot 1999; Tourtellot et al. 2003; Tourtellot et al. 1999). Studies indicate that this was also true for the ancient Maya, for whom visibility played a central role in communicating information about the ability of individuals of high status to have the power to be “all-seeing” and consequently “all-knowing” (Houston et al. 2006). This means that individuals who lived at highly visible sites were most likely viewed as more powerful than those who did not. This is done by measuring *topographic prominence*, or the overall visibility of an object or site within a landscape. In the case of Copán, this means evaluating sites across the Copán Valley (Llobera 2001, 2003, 2006).

However, another way to evaluate the communicative role of visibility is to look at the visibility of a site not only with respect to all other sites, but with respect to sites of different types. For this study, that means evaluating the *intervisibility* among sites types 1−5 in the valley. The intervisibility among site types provides information on the visual lines of communication between different social groups. For example, we can test whether people living at type 4 sites were more visually connected with those of their same social class, who also lived at type 4 sites, or if they were more visually connected with people of lower social status living at type 1 or 2 sites. This information provides clues as to whether it was more important to be in contact with or keep on eye on someone of equivalent status or if it was more important as an elite to be in contact with or appear “all-seeing” to commoners. Ultimately, intervisibility provides information on addresser and addressee, that is, who is sending messages to whom (Goffman 1983; Jakobson 1980).

Most visibility studies in the Maya region use line-of-sight to reconstruct visibility between buildings and freestanding monuments. While useful in their own right, they are limited in their ability to reconstruct the impact of visibility on pedestrian movement and on audience. Line-of-sight analyses reconstruct visibility along a fixed line and thus do not take into account the effect of the surrounding landscape. In contrast, viewsheds, which calculate an object's entire 360° field-of-view, take into account the entirety of a landscape and thus provide a (quantitative) way to measure topographic prominence and intervisibility.

Creating Viewsheds

The Urban-View DEM served as the base file from which to create viewsheds for the 82 sample sites. The sites comprised 67 residential sites, seven monumental buildings in the Principal Group, the Royal Courtyard, and Copán's seven valley stelae (see Appendix E for list of sites). (The seven valley stelae were not part of the 74 sample sites used in the visibility analysis; the valley stelae were only used in the directionality analysis.) A viewshed identifies all cells visible from one or more "viewpoint" cells situated on a surface. In a GIS, all non-visible cells are assigned a 0 and all visible cells are assigned a 1 (see Appendix H for maps of viewsheds generated for sample sites and valley stelae). This numerical labeling is useful in determining how visible objects are within a landscape.

Most viewsheds are calculated using point data (as source) in a GIS; however, because this dissertation research is interested in the visibility of sites, not necessarily individual objects, polygon data rather than point data were used. It was not feasible to select the center point of sites (as is often done) because this method would have resulted in the interior view of a site rather than the exterior view (its visibility to non-residents), not providing any information on a site's topographic prominence or intervisibility.

Because polygon data include mass (or area), they allow us to overcome the problems associated with using point data.

In this process, each of the 82 sample sites was selected from the *structures* shapefile and exported as 82 new shapefiles, a process executed in ArcGIS. The viewsheds were actually generated using IDRISI (Andes version), a GIS and image processing software. It was necessary to use IDRISI because ArcGIS does not have the ability to generate viewsheds from polygon data (only points and lines). I proceeded as follows:

1. The shapefiles were imported into IDRISI as a vector (.vct) file
2. The vector file was reformatted into a raster (.rst) file and the image parameters were copied from the Urban-View DEM.
3. The viewshed was generated using the specified parameters
4. The viewshed was exported as a GEOTIFF, an uncompressed raster file that maintains spatial reference.
5. The GEOTIFF was imported into ArcGIS as an ESRI grid (raster format) for analytical purposes.

I then used 82 generated viewsheds to identify the topographic prominence of monumental buildings and freestanding monuments and the intervisibility among Copán's five site types. In addition, I generated cumulative viewsheds for Maca's (2002) four "U-shaped structures" said to delimit the city's urban core: Groups 9J-5, 7M-8, 9N-8, and 11K-6. Cumulative viewsheds highlight locations in the landscape that are visible from multiple viewpoints (areas of visual overlap) (see Appendix H for viewsheds). I did this to determine if common areas of visibility could be identified that could possibly support Maca's (2002) argument that these groups mark an urban boundary.

The process of creating this cumulative viewshed did not involve simply adding together the four initial viewsheds; instead, a classification scheme was devised to reclassify the cells in each viewshed. For all non-visible areas the values (value = 0) were not changed; however, the values for visible areas were assigned unique values (the same unique value was assigned to all visible cells in a single viewshed). This step created reclassified viewsheds that resulted in values representing unique combinations. In Table 5.3, "U-Groups" refers to visible sites and "Reclassified Values" indentifies the value in the cumulative viewshed (equating to specific locations in the Copán Valley) at which a particular U-Group or set of U-Groups is visible. For example, at any location with a value = 7, a person can simultaneously see three of the U-Groups, 9J-5, 7M-8, and 9N-8, but they cannot see the fourth, U-Group 11K-6. This approach provides information on common areas from which Copán's four cornerstone sites could be seen.

Table 5.3*: Reclassification scheme for Copán's four U-Groups cumulative viewshed*

U-Groups	Reclassified Values
9J-5	1
7M-8	2
9N-8	4
11K-6	8
9J-5 + 7M-8	3
9J-5 + 9N-8	5
7M-8 + 9N-8	6
9J-5 + 7M-8 + 9N-8	**7**
9J-5 + 11K-6	9
7M-8 + 11K-6	10
9J-5 + 7M-8 + 11K-6	11
9N-8 + 11K-6	12
9J-5 + 9N-8 + 11K-6	13
7M-8 + 9N-8 + 11K-6	14
9J-5 + 7M-8 + 9N-8 + 11K-6	15

Calculating Topographic Prominence

Topographic prominence, or a site's overall visibility, was calculated by dividing the number of visible pixels from each viewshed by the total number of pixels in the viewshed (i.e., non-visible and visible pixels). Based upon this number, I calculated the percentage representing each sample site's overall visibility in the Copán Valley. These data provided information on whether or not particular areas of the valley (physiographic zones, urban vs. hinterland, and *sian otots*) had greater topographic prominence than others. However, in order to calculate if individual site types (1−5) were more visible than others, the viewsheds for each site type needed to be "extracted."

This process was accomplished using the *Extract by Mask* function from the Spatial Analyst Tools in ArcGIS. Each of the site type shapefiles was used as a mask and overlaid on the viewsheds so that only the visibility data for that particular site type was spatially extracted. I repeated this procedure four times for each sample site viewshed, resulting in a total of 328 extracted viewsheds. At this point, I calculated percentage visibility for all sites by dividing the number of visible pixels within a specific site type by the total number of pixels for that site type. Pixels in this case correspond to the area in square meters, a site type occupies in the Copán Valley. For example, in calculating the visibility of Structure 10L-22, a monumental structure in the Principal Group, in relation to type 1 sites, the total number of pixels in the viewshed is 22,933. The non-visible areas make up 10,753 pixels and the visible areas make up the remaining 12,180 pixels. To calculate percentage visibility for Structure 10L-22 (type 5) to all type 1 sites, it is necessary to divide 12,180 by 22,933, yielding a visibility of 53.11%. This means that from approximately 53% of type 1 structures in the Copán Valley the massive ceremonial structure of Structure 10L-22 can be seen.

This method provides information on the overall visibility between different site types; however, it does not account for the total number of visible sites per site type. In the above scenario, we may know that Structure 10L-22 is visible from 53% of the total area occupied by type 1 sites, but we do not know from how many discrete sites this monumental structure can actually be seen. For example, of the 434 type 1 sites at Copán, it is important to know whether that 53% visibility encompasses 150 or 300 sites. If individuals living at 300 distinct type 1 sites can see Structure 10L-22, the building has a large "audience"; however, if the building is visible from only 150 type 1 sites, then its "audience" is only half as large.

To calculate the actual number of sites visible from each sample site (and not simply the percentage visibility), I then converted each of the 328 extracted viewsheds from a raster format to a vector format. This step was required in order to *union* the attributes from the four site type shapefiles to the visibility data in these newly vectorized files. In other words, it was necessary to assign site labels (e.g., Group 11K-6) to the sites in each extracted viewshed, which at this point did not have any attribute information beyond non-visible or visible. The next step was to generate a data output table for each viewshed that summarized the total number of visible and non-visible sites; 328 data output tables were generated (see Appendix F for sample tables).

These tables were imported into *Minitab 15* to test whether or not statistically significant differences existed in the intervisibility of site types 1−5 at Copán. A multi-scalar approach was employed to evaluate if differences and/or similarities in intervisibility existed at different scales within the valley. This approach allowed me to address the following questions. (1) *Did significant differences in the intervisibility of site types exist at the valley-wide scale, or were such differences muted by the valley's large area (Longley et al. 2005)?* (2) *Were there significant differences in the intervisibility of site types based on ecological factors, that is, differences among the valley's physiographic zones?* (3) *Did significant differences in the intervisibility of site types exist between the urban core and its surrounding hinterlands?* (4) *Did Copán's* sian otots *exhibit significant differences in the intervisibility of site types, that is, were some site types highly visible from some sub-communities but not from others?* The answers to these questions helped to reconstruct the paths of visual communication among people living at Copán's different site types and at different locations within the valley. In other words, these results provided information on audience (addressers and addressees) or who was sending messages to whom, ultimately enriching our understanding of social dynamics among ancient Copanecos.

Directionality Analysis: A Subset of Visibility

Visibility studies show that overlapping visual spheres and visual boundaries often highlight spatial temples, activity patterns, cultural groupings, and communication flow (Llobera 2003, 2006; Maples 2004; Wheatley and Gillings 2000). Although relatively new to the Maya region, studies of directionality are not new to archaeology. For example, archaeologists have studied the relationship between landscape views and directionality for the megaliths of northern Europe, ancestral Puebloan sites of the U.S. Southwest, and other hilltop sites throughout the world (Llobera 2001, 2006; Maples 2004). While researchers have used a variety of approaches to evaluate directionality (both qualitative and quantitative), David Wheatley and Mark Gillings (2000), two leading experts in both GIS and archaeology, have introduced a straightforward approach for quantitatively measuring directionality.

Their approach employs a GIS to create viewsheds that can be used to determine if particular fields-of-view exhibit directionality. They base their methodology on a series of indexes defined by Tadahiko Higuchi (1983) that affect the visibility of objects in a landscape. These indexes are: visibility/invisibility; distance; angle of incidence; depth of invisibility; angle of depression; and angle of elevation (Higuchi 1983). In a GIS, the standard binary viewshed (0 = non-visible pixels, 1 = visible pixels) can account for all of these indexes except for distance. To account for distance, a “Higuchi Viewshed” needs to be generated from the standard binary viewshed.

Wheatley and Gillings (2000) define an eight-step process for creating a “Higuchi Viewshed:”

1. Calculate near-, mid-, and far-distance zones using Higuchi criteria
2. Calculate a binary viewshed for a location
3. Calculate a distance layer from the location
4. Reverse the distance layer to record decreasing value from the location
5. Derive an aspect layer from the reversed distance layer
6. Reclassify aspect layer into directional zones (N, NE, E, SE, S, SW, W, NW)
7. Overlay the binary viewshed over the reclassified aspect layer and use near-, mid-, and far-distance zones to extract in-view areas
8. Produce a histogram or summary statistics for the proportion of cells in the in-view areas for each directional zone.

I have modified this process to account for differences between the GIS software used in this research (ArcGIS 9.1) and the software used by Wheatley and Gillings (2000). This modified approach has nine steps:

1. Calculate near-, mid-, and far-distance zones using Higuchi criteria
2. Calculate a binary viewshed for a location
3. Create multiple buffers using calculated Higuchi distance zones
4. Convert multiple buffers to Triangulated Irregular Network (TIN)
5. Create aspect layer from TIN
6. Convert Aspect TIN to raster

7. Use map algebra to multiply the binary viewshed by the reclassified aspect layer
8. Use near-, mid-, and far-distance zones to extract in-view areas
9. Produce a histogram or summary statistics for proportion of cells in the in-view areas for each directional zone (see Appendix B for details of method).

Step 1 is the only step performed outside of the GIS. These near-, mid-, and far-distance zones are based on Higuchi's (1983) division of the visual landscapes into three categories: near-distance (foreground); middle-distance (middle ground); and far-distance (background). The distances for these three zones are not standardized, but vary depending on standard object height in a landscape. In this case, the standard object(s) were the residential structures of the Copán Valley. Structures classified in the near-distance are perceived as being immediate and close to the viewer. The visibility of structures in this class was calculated using a horizontal angle of 1°, or approximately 60 times the size of the average structure. Structures assigned to the middle-distance are visible, with a discernible size and shape, but they lack details (e.g., presence or absence of architectural sculpture is indiscernible). Their visibility was calculated using a horizontal angle of 3°, equal to a distance of 1,100 times the size of the average structure. The far-distance is defined beyond the middle-distance to infinity, and while individual structures are no longer identifiable, clusters of buildings are still visible.

The standard height for residential structures (excludes the civic-ceremonial buildings of the Principal Group) was calculated at 4.7 meters. Using this figure and the appropriate horizontal angle (see above), distances for Higuchi's three visibility classes were calculated: (1) the near-distance visibility range was 0−282 meters, (2) the middle-distance range was 283−5170 meters, and (3) the far-distance range was 5,171 meters to the valley boundaries. These distances were then used to generate "Higuchi Viewsheds" for dominant households in each of Copán's *sian otots*, as defined by Leventhal (1979) and Fash (1983a) (see Chapters 8 and 9 for directionality viewsheds). (Given the large number of elite households in Las Sepulturas and El Bosque, a single dominant household could not be selected; therefore, two sites, believed to be two of the most important at Copán, were selected for the analysis.) I decided to focus on Copán's dominant households in order to investigate whether directionality of view could be used to provide further insight as to the role visibility may have played in communicating messages to particular audiences. By defining the elite living at dominant households as addressers, the identity of potential addressees, that is, the likely recipients of visual messages, were identified.

Overview of GIS Methodology

Many steps were involved in the design and development of the GIS database. Generally speaking, these steps included:

1. Scanning and georeferencing maps and architectural plans and drawings
2. Georeferencing these scanned images
3. Digitizing archaeological and natural features from these georeferenced images to create shapefiles
4. Converting polylines shapefiles to polygon shapefiles
5. Attributing shapefiles (site types, group ID, structure ID, known heights)

6. Calculating unknown heights (unexcavated sites) using trigonometry function based on Harvard Site Typology
7. Converting shapefiles to raster files
8. Creating Friction Surface to calculate least-cost routes
9. Creating Urban-View DEM to generate viewsheds
10. Creating Higuchi Viewsheds to measure directionality

These data were created using ESRI's ArcGIS *9.1*, a GIS software package, and subsequently analyzed using both ArcGIS and IDRISI Andes, a GIS and image-processing software. *Minitab 15*, a statistical software package, was used to evaluate the statistical significance of the integration and visibility analyses.

This dissertation research takes advantage of recent advances in GIS technologies, specifically the ability to create, process, and analyze raster data and to carry out complex spatial analyses on these datasets. In archaeological studies, the most common type of raster dataset is the Digital Elevation Model (DEM). Most DEMs are typically low-resolution (e.g., 90-meter resolution in Central America) and include only elevation values from the natural topography. This means that the majority of GIS archaeological analyses employing standard and readily-available DEMs (and to date all such investigations in the Maya region) are able to carry out only regional (small-scale) studies. In contrast, this dissertation research uses DEMs to carry out an intra-site analysis. Such an analysis is possible only because (1) large-scale maps exist for Copán that include 2-meter contour lines and footprints for the valley's known structures and (2) a trigonometric function using these footprints was derived to calculate unknown structure heights and create a high-resolution Urban DEM (derived from 20 centimeter and 1.5 meter data) for Copán.

This Urban-DEM is the fundamental component of the integration and visibility analyses carried out in this dissertation. It provides a high-resolution surface that allows archaeologists to take into account the combined effects slope, waterways, roads, walls, buildings, and other features have on travel costs and visibility. The Urban-DEM accomplishes this by storing not only elevations from natural topography, but also building and stairway heights. In addition, it stores data on other infrastructure, including barriers such as walls, streams, and rivers that often inhibit or impede movement and/or visibility and facilitators such as roads that typically promote movement and increase or decrease the likelihood that particular places can be seen (as in more or less frequently traveled paths). In sum, the Urban-DEM developed for this research serves as the mechanism for reconstructing the Maya *kahkab* by integrating the natural and built environments into a single dataset from which to measure access and visibility, and ultimately better understand how site configuration may have helped to shape and maintain a social hierarchy at Copán.

Chapter 6:

Access (Integration) Analysis

Archaeologists assume that the accessibility of particular spaces reflects sociopolitical organization. Studies have shown that restricted spaces reflect hierarchical organization, centralized power, and greater degrees of social segregation, whereas open spaces signify more distributed power and less segregation (Canuto 2004; Stuardo 2003). At Copán, scholars have talked about the relative accessibility of the Great Plaza in comparison to the inaccessibility of the Acropolis; however, this is the first research to quantitatively measure the differences in access between the two areas. In addition, this is the first study to test the assumption that access to the Great Plaza and the Acropolis reflects larger scales, that is, it moves beyond Copán's civic-ceremonial center and examines access relationships among people living at residential sites across the entire valley. The study's findings support many of the current assumptions about access in the valley, including the assumption that the Great Plaza was the most accessible location in the valley and that site organization directs certain people to elite households. However, this research also reveals unexpected spatial relations that raise new questions about Copán's social organization and the traditional classification of its sites (the Harvard Site Typology).

Another important way in which this study differs from others is that it takes into account both the natural landscape and the built environment, a unity that the contemporary Maya refer to as the *kahkab*. The unique capabilities of a Geographic Information System allowed a quantitative access analysis that integrated these two aspects of ancient Copán. It provided the tools to create the Urban Digital Elevation Model (DEM) through which to take access measurements to determine whether or not Copán's five site types exhibit differential accessibility. Identifying such differences made it possible to address whether or not ancient Copanecos may have organized their city to help create and maintain a social hierarchy by establishing greater connectivity between certain groups of people. The Urban DEM was used to generate pathcosts for the five site types posited in the Harvard Typology. The pathcosts for each site type provide information on social connectivity within and among different social groups because they serve as measures of the likelihood that people will walk to or by specific site types. For example, the ancient Maya living at sites with low pathcosts would have been more integrated, or connected, with society as a whole because other people would have been more likely to walk to or by them (Bustard 1996; Ferguson 1996; Hillier 1996; Hillier and Hanson 1984; Hillier et al. 1993; Ratti 2005; Shapiro 2005). In contrast, the ancient Maya living at sites with high pathcosts would have been less connected to each other. These pathcosts, referred to as integration values, measure the degree of connectivity among different site types across the landscape. Locations with low integration values were more accessible than those with higher integration values (Hillier 1996; Hillier and Hanson 1984; Hillier et al. 1993).

The integration values for different site types provide information on ancient social inequality and class structure because they are related to variables such as political control, ritual inclusion/exclusion, and access to resources (Smith 2007). For example, many people living in Copán at highly integrated sites also had greater access to the city center and its main civic-ceremonial buildings; the cost of travel from their homes to other places within the city was relatively low. For people living at less integrated sites the cost of travel was much higher, leading to greater segregation for these residents (Ratti 2005). The integration values provided information that was used to address questions about site accessibility, such as, *Were commoners living at type 1 and 2 sites more segregated than the elite residing at type 3 and 4 sites?* For analytical purposes, I divided site type 5 (Copán's main civic-ceremonial complex) into three distinct units, the Great Plaza, the Acropolis, and the Royal Court (see Figure 2.21) to address more specific questions about the accessibility of Copán's civic-ceremonial precinct, such as, *Was the Great Plaza more accessible than the Acropolis or the Royal Courtyard? Did people living at type 3 or 4 sites have greater access to the spaces of Ruler 16's private courtyard than those living at type 1 or 2 sites?*

This chapter describes the access data and lays out the results of the accessibility analysis at four scales. From largest to smallest these are, the entire valley, the physiographic zones, the urban core−hinterland, and the sub-communities (*sian otots*). The results of this approach highlight the importance of multi-scalar research as a method identifying patterns for comparing large-scale, intermediate, and local level sociopolitical processes.

Description of Access Data

Processing high-resolution raster datasets is time-consuming; it was not feasible to generate pathcosts for all of Copán's 594 known Late Classic sites. On average it took three hours to generate least-cost paths for an individual site, not including pre-processing or post-processing time. To generate paths for all 594 known sites, it would taken approximately 1,782 hours; working eight hours per day that would be 223 days needed simply to generate the paths.

Instead, I used a stratified random sampling strategy to select 74 source sites (or start locations) for which to calculate pathcosts (see Appendix E for list of sites). The sample sites included site types 1–4 from across the valley, each physiographic zone, the urban core and its hinterland, the valley's twenty *sian otots*, and locations within the Principal Group (Figure 6.1). Least-cost paths were generated from the 74 source sites to all 594 sites (destinations) within the valley. The destinations included 443 type 1 sites, 110 type 2 sites, 25 type 3 sites, and 16 type 4 sites.

To determine least-cost paths from all the source sites to a given destination, the pathcosts for each source site were stored in separate GIS attribute tables based the site type of the destinations. The pathcosts were exported from the GIS into Microsoft Excel and then grouped according to site type, physiographic zone, urban core–hinterland, and *sian otot* to allow for a multi-scalar analysis (see Appendix D for Excel files).

The attributed pathcosts were imported into the statistical software package *Minitab 15* to perform an analysis of variance on the integration values and determine if distinct integration patterns existed at the different scales of analysis, and, if so, whether these patterns differed depending on site type. The Kolmogorov-Smirnov test for normality indicated that the data were non-normally distributed, that is, they did not cluster around a mean or represent a bell curve. Therefore, two non-parametric tests—Kruskal-Wallis and Mann-Whitney—were employed.

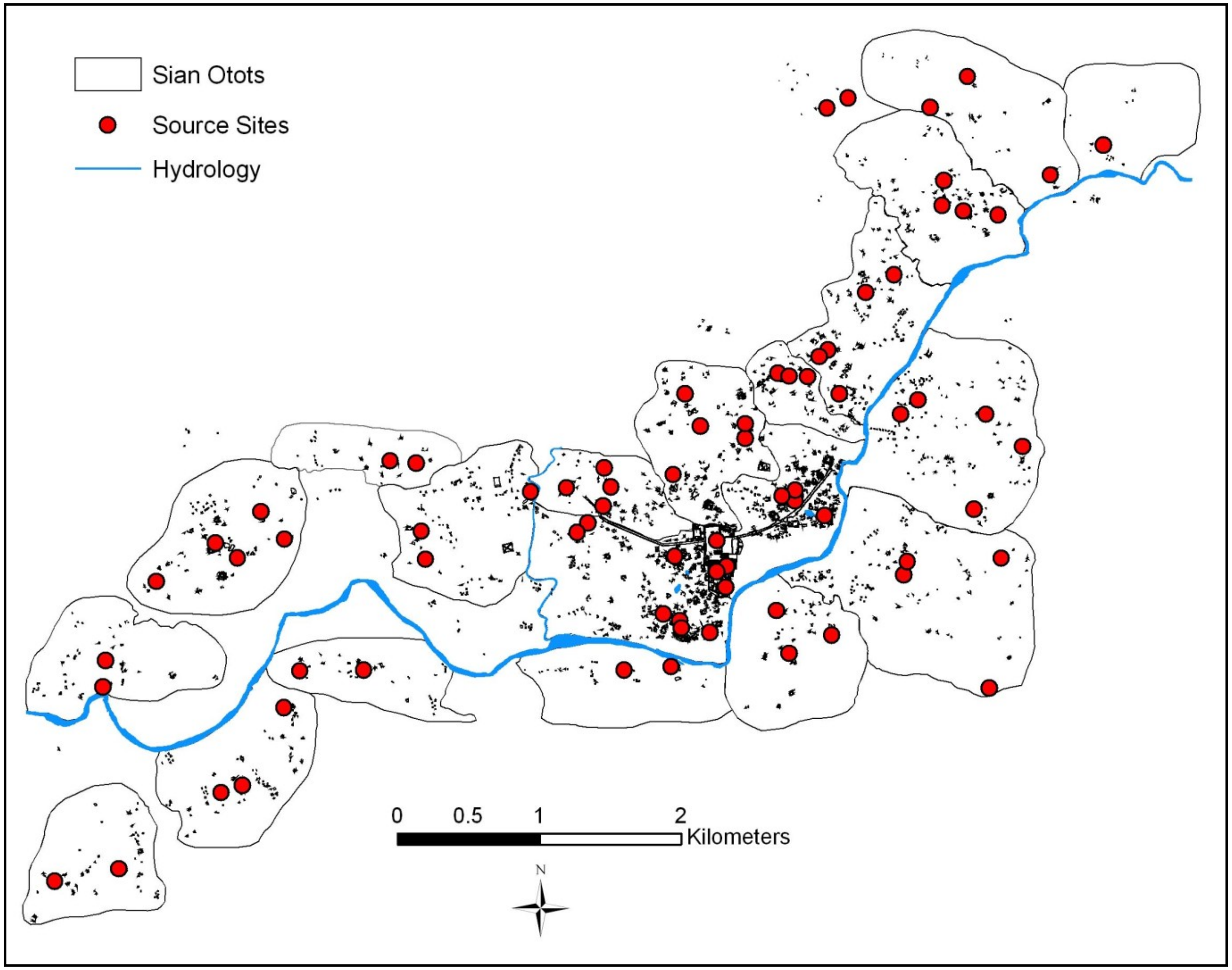


Figure 6.1: **Source sites for access analysis in Copán Valley**

The Kruskal-Wallis test offers an alternative to the ANOVA (one-way analysis of variance) for determining if significant differences exist in the integration values of different groups. The tables showing the Kruskal-Wallis results for this part of the analysis give the integration values and the overall p-value for each. If the p-value is < 0.05, it means that there is at least a 95% chance that statistically significant differences exist among the integration values.

For those cases with significant differences, the Mann-Whitney test provided a pair-wise comparison among groups to identify the groups that were driving the variation. The Mann-Whitney tables compare the integration values between pairs of site types: type 1 to type 2, type 1 to type 3, type 1 to type 4, and so forth. An *N* indicates that significant differences do not exist between the site types, and a *Y* indicates that significant differences do exist. When significant differences exist, the significance level is provided. Such pair-wise comparisons are important because they provide information on the relative intensity of sociopolitical control at different scales in the valley. That is, little or no significant difference in the integration values of site types suggests that people living at different site types experienced similar degrees of sociopolitical control; differences in access between site types that are statistically significant indicate that people living at different site types experienced different degrees of sociopolitical control.

Accessibility of Copán's Site Types at the Valley-Wide Scale

The valley-wide analysis was the first step in testing the hypothesis that the ancient Maya at Copán configured their built environment to help shape and maintain a social hierarchy. Based on the assumption that as social status increases social connectivity (accessibility) increases, I expect the following pattern:

1. Copán’s only type 5 site, the Principal Group, will have the lowest integration values of any site type, that is, the highest accessibility.
2. The Great Plaza will be more accessible than the Royal Courtyard and the Acropolis
3. Elite sites will be more integrated than commoner sites.
4. Type 4 sites will be more highly integrated than type 3 sites
5. Type 2 sites will be more highly integrated than type 1 sites

The Kruskal-Wallis test suggests that, at the valley-wide scale, significant differences existed in the accessibility of Copán’s different site types (Table 6.1).

Table 6.1*: Kruskal-Wallis test: valley-wide accessibility results*

Site Type	N (paths)	Integration Value
1	25890	7246
2	3465	6297
3	1469	5842
4	925	5136
Great Plaza	586	**3412**
Acropolis	587	4130
Royal Courtyard	583	4061
p-value = <0.0001		

The Mann-Whitney test (for pair-wise comparisons) indicates that all site types in the valley exhibit significant differences in accessibility, with the exception of the Acropolis and the Royal Courtyard (Table 6.2).

Table 6.2*: Mann-Whitney test: valley-wide accessibility results*

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]Y	[1]Y	[1]Y	[1]Y	[1]Y	[1]Y
Type 2			[2]Y	[1]Y	[1]Y	[1]Y	[1]Y
Type 3				[3]Y	[1]Y	[1]Y	[1]Y
Type 4					[1]Y	[4]Y	[1]Y
Great Plaza						[1]Y	[5]Y
Acropolis							N
Royal Courtyard							

Significance level: [1]< 0.0001 [2] 0.0014 [3] 0.0008 [4] 0.0044 [5]0.0001

Looking specifically at the integration values in Table 6.1, it is evident that the Great Plaza was the most accessible. These results suggest that the configuration of Copán made it easier for commoners and elite living at different site types to travel from their homes to the open, public spaces of the Great Plaza. The fact that the Acropolis and Royal Courtyard were less accessible than the Great Plaza supports the belief that the ruler restricted direct access to the interior spaces of the Acropolis and Royal Courtyard to members of the royal court, certain elite, foreign dignitaries, and royal servants. However, the low integration values of the Acropolis and Royal Courtyard, in comparison to site types 1−4, reflect the importance of locating the civic, ceremonial, and administrative centers in a highly accessible location. In general, the low values for the Principal Group reflect the desire or need of ancient Copanecos to have ease of access to the city's major civic-ceremonial complex and the Royal Compound. Close proximity to the king would have been necessary for retainers and servants of the royal court and would have afforded some prestige to the area's residents (Budet-Reentis 2001; Inomata and Houston 2001).

Although archaeologists realize that some sites were multi-functional, site types 1, 2, 3, and 4 are considered to have been primarily residential. The Kruskal-Wallis test indicates that people living at type 1 and 2 sites, presumably commoners, were the least integrated with society as a whole. In contrast, individuals living at type 3 and 4 sites, presumably the elite, their servants, and possibly lesser kin (Hendon 1987, 1991; Webster 2005), were more integrated. These results suggest that at the valley-wide scale, the elite positioned themselves in locations across the Copán Valley that would allow them to exercise greater social control. They created seats of power to which people would have been channeled, enabling them to more easily carry out their administrative and ceremonial duties (Ashmore 1991; Hillier and Hanson 1984). Although these findings are intriguing, they raise a new question: whether these patterns persist at other scales of analysis. By measuring accessibility for the valley's physiographic zones, I was able to test this question and investigate whether outside variables, such as ecology, settlement density, or site type had any effect on the level of integration.

Assessing Measurements of Accessibility for the Valley's Physiographic Zones

Accessibility was measured in two ways for four of Copán's five physiographic zones (Zone 1 is devoid of archaeological sites and was not included) (W. Fash 1983a; Willey et al. 1978). (See Chapter 2 for zone descriptions.) First, each zone's overall accessibility was measured to determine if certain areas of the valley were more accessible than others, and the results were compared to landform, slope, and settlement density for that zone. For this step, I aggregated all site types. Second, I measured the accessibility of different site types within each zone for two purposes: (1) to test if the presence of particular site types influenced the overall accessibility of physiographic zones and (2) to determine whether different zones exhibited distinct spatial hierarchies that made some site types more accessible than others.

Results: Overall Accessibility for Zones

The Kruskal-Wallis test indicates that significant differences existed in the overall accessibility of Copán's physiographic zones. Table 6.3 shows that Zone 2, a low river terrace north of the Río Copán in the center of the valley, had the lowest integration values (highlighted in bold), and therefore people living there were more integrated with society as a whole than residents living in Zones 3–5. The central location, gentle slope, and high settlement density of this zone explain, in part, the low cost of travel between sites in this region. The fact that this area housed the site's major civic-ceremonial monuments and plazas, the Principal Group—the site type with the lowest integration values (Table 6.1)—also contributed to the zone's overall low integration values.

Table 6.3*: Kruskal-Wallis test: accessibility results for physiographic zones*

Zone	N	Integration Value
2	5136	**4425**
3	14759	5951
4	6817	5535
5	9781	11126
p-value = <0.0001		

Table 6.4*: Mann-Whitney test: accessibility results for physiographic zones*

	Zone 2	Zone 3	Zone 4	Zone 5
Zone 2		[1]**Y**	[1]**Y**	[1]**Y**
Zone 3			**N**	[1]**Y**
Zone 4				[1]**Y**
Zone 5				
Significance level: [1]<0.0001				

Although Table 6.3 shows that integration values for Zone 4, the foothills and high and low river terraces south of the river, are slightly lower than the values for Zone 3, the foothills north of river, the Mann-Whitney test indicates that these values are not significantly different (Table 6.4). Zone 4, an area with relatively sparse settlement, consists of rugged terrain south of the Río Copán. This zone contained much of the valley's agricultural land (Leventhal 1979). Zone 3, in contrast, was densely occupied and housed many of the valley's residences on its gently sloping hills (W. Fash 1983a; Leventhal 1979). A lower cost of travel to sites located in this region was expected. Surprisingly, however, the integration values of the two zones are not significantly different. These results support the belief that landform and elevation were not the only factors contributing to accessibility in the valley.

Zone 5, an ecologically diverse area in the western half of the valley, has integration values that are two to three times higher than the values for Copán's other physiographic zones. These results indicate that it was very costly for people living in this area to travel to other sites within the valley, So that Zone 5 residents were more segregated from society as a whole than people living in other zones. It is difficult to correlate Zone 5's high integration value with a specific landform because the region includes many diverse landforms, including low and high river terraces, foothills, and an intermountain valley (W. Fash 1983a).

The results for Zones 2–5 suggest that ecological variables themselves do not account for the variation seen in the integration values. *Perhaps a more socially constrained variable, such as settlement density, also contributes to integration values.* One would assume that the closer together people live, the lower their integration values, and the lower the cost of travel to neighboring sites. Figure 6.2 shows that there are marked differences in settlement density among the zones. However, a comparison of settlement density and integration value in each zone (Table 6.5), demonstrates that there is not a direct correlation between settlement density and access. For example, Zones 3 and 4 have similar integration values, 5951 and 5535 respectively, yet they have very different settlement densities—320.45 persons/km^2 and 84.13 persons/km^2, respectively.

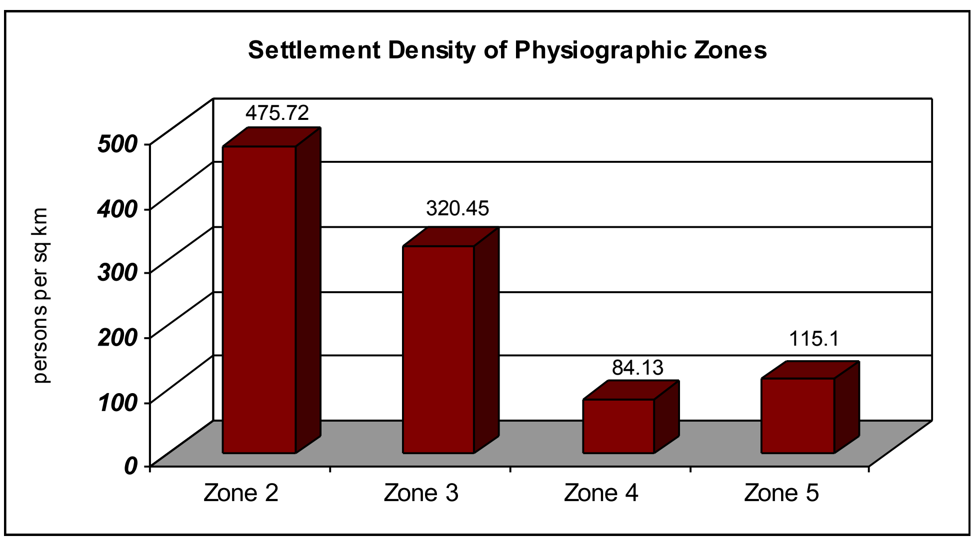


Figure 6.2: **Settlement density for Copán Valley physiographic zones**

Table 6.5: ***Comparing integration values for physiographic zones to settlement density***

Zone	Integration Value	Settlement Density
2	**4425**	475.72
3	5951	320.25
4	5535	84.13
5	11126	115.10

The conclusion is that while factors such as landform, slope, and settlement density contribute to integration values across the Copán Valley, some additional factor(s) are influencing accessibility within different physiographic zones. I hypothesize that one such factor is site type. By using GIS in a new way, this research creates new possibilities for calculating and comparing integration values of individual site types for each zone in order to test this hypothesis. For the analysis the sample sites in each zone were tested against every other site in every other zone. The goal was to determine how integrated the occupants of different zones were with people living at specific site types in the rest of the valley, not to determine the accessibility of specific site types within zones.

Accessibility of Site Types in Zone 2

The Kruskal-Wallis test indicates that significant differences exist in the accessibility of site types in Zone 2, the location of the Principal Group. The integration values in Table 6.6 show that the Great Plaza was the most accessible location in this area. In other words, it cost less for pedestrians living in Zone 2 to travel to the Great Plaza than to any other site type. The Royal Courtyard was the second most accessible location, supporting the belief that many people may have lived in Zone 2 in order to maintain close proximity to the ruler and play a role in the royal court (Webster 2001).

Table 6.6*: Kruskal-Wallis test: accessibility results for Zone 2*

Site Type	N (paths)	Integration Value
1	3526	5746
2	873	3771
3	199	3541
4	124	2675
Great Plaza	141	**1783**
Acropolis	139	2515
Royal Courtyard	134	2083
p-value = <0.0001		

In general, Copán's major monuments were highly accessible, and the city's elite residences were more accessible than those of commoners, to people living in the center of the valley. The Mann-Whitney test indicates that the integration values of all site types, with the exception of type 4 sites and the Acropolis, are significantly different (Table 6.7). Interestingly, although type 3 and 4 sites are both designated as elite, type 4 sites have significantly lower integration values than type 3 sites. In fact, the integration values of type 3 sites are much closer to the values of type 2 sites than to the values of type 4 sites. The lower integration values of type 4 sites compared to type 3 sites indicates that the elite living at type 4 sites were more centrally located. These results suggest that the center of the valley was organized to channel movement to or by type 4 sites, possibly to facilitate interaction with the occupants living at these sites and/or to guide pedestrians by these elaborately built structures to emphasize their wealth and prominent status. The majority of type 1 households across the valley were not closely connected to people living in the center of the valley, suggesting that there was little need for them to interact with each other on a daily basis.

Table 6.7: ***Mann-Whitney test: accessibility results for Zone 2***

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		**[1]Y**	**[1]Y**	**[1]Y**	**[1]Y**	**[1]Y**	**[1]Y**
Type 2			**[2]Y**	**[1]Y**	**[1]Y**	**[1]Y**	**[1]Y**
Type 3				**[3]Y**	**[1]Y**	**[1]Y**	**[1]Y**
Type 4					**[1]Y**	**N**	**[4]Y**
Great Plaza						**[1]Y**	**[1]Y**
Acropolis							**[1]Y**
Royal Courtyard							
Significance level: [1]< 0.0001 [2]0.0398 [3]0.0011 [4]0.0005							

Accessibility of Site Types in Zone 3

The Kruskal-Wallis test indicates that significant differences exist in the accessibility of site types in Zone 3, the foothills north of the river (Table 6.8). As in Zone 2, the Great Plaza was the most accessible location, and people living at type 1 sites were the least integrated.

Table 6.8: ***Kruskal-Wallis test: accessibility results for Zone 3***

Site Type	N (paths)	Integration Value
1	10474	6389
2	2629	5245
3	597	5312
4	374	4464
Great Plaza	226	**3372**
Acropolis	229	4308
Royal Courtyard	230	4469
p-value = <0.0001		

However, the Mann-Whitney test indicates fewer statistically significant differences in the integration values of Zone 3 sites than of Zone 2 sites (Table 6.9). Significant differences exist between type 1 sites and all other site types, as well as between type 2 sites and type 4 sites, but significant differences do not exist in the integration values between type 2 and type 3 sites and type 3 and type 4 sites.

Table 6.9*: Mann-Whitney test: accessibility results for Zone 3*

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]Y	[1]Y	[1]Y	[1]Y	[1]Y	[1]Y
Type 2			N	[2]Y	[1]Y	N	N
Type 3				N	[1]Y	N	N
Type 4					[3]Y	N	N
Great Plaza						[1]Y	[1]Y
Acropolis							N
Royal Courtyard							
Significance level: [1]< 0.0001 [2]0.0220 [3]0.0003							

The lack of significant differences in the integration values of some Zone 3 site types indicates that the movement the residents was not as closely controlled as it was for Zone 2 residents. For example, people living in Zone 2 found it significantly easier to travel to a type 4 site than a type 3 site; in other words, movement to type 4 sites was facilitated. In contrast, people living in Zone 3 found it just as easy to travel to type 3 sites as type 4 sites. The results suggest that channeling movement to specific site types was less controlled or less important in the foothills north of the river.

Accessibility of Site Types in Zone 4

The Kruskal-Wallis test indicates that significant differences exist in the accessibility of different site types from Zone 4, the foothills and high and low river terraces south of the Río Copán. Table 6.10 shows that the Great Plaza was the most accessible site type and type 1 sites were the least accessible. Interestingly, although the overall differences in integration values of Zones 3 and 4 are not significantly different (see Table 6.4), the Mann-Whitney test indicates that sites in Zone 4 exhibit more significant differences in integration values than sites in Zone 3. Unlike Zone 3, site types 3 and 4 have significantly different integration values, indicating that people living in

Zone 4 had significantly greater access to type 4 sites than to type 3 sites. The results suggest that Zone 4 residents found it easier to travel to type 4 sites and therefore probably interacted on a more frequent basis with the residents of type 4 sites than with the occupants of type 3 sites.

Table 6.10: ***Kruskal-Wallis test: accessibility results for Zone 4***

Site Type	N (paths)	Integration Value
1	4837	6049
2	1207	5146
3	275	4838
4	172	4435
Great Plaza	108	**3723**
Acropolis	109	4509
Royal Courtyard	109	3757
p-value = <0.0001		

Another notable difference between Zones 3 and 4 is that the Acropolis and the Royal Courtyard have significantly different values (Table 6.11). The Royal Courtyard was more accessible to people living in Zone 4 than it was to people living in Zone 3. These lower integration values may indicate that the people living in Zone 4 played a role in the royal court or maintained an important economic relationship with the king. For example, Zone 4's expansive agricultural lands may have belonged to the king, necessitating closer supervision than other agricultural lands in the valley. Perhaps the residents of Zone 4 served as artisans or servants for the king and the royal court. As in Zone 3, the integration values of type 2 and type 3 sites are not significantly different, indicating that Zone 4 residents had equal access to people living at both of these site types across the valley.

Table 6.11: *Mann-Whitney test: accessibility results for Zone 4*

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]Y	[1]Y	[1]Y	[1]Y	[1]Y	[1]Y
Type 2			N	[1]Y	[1]Y	[1]Y	[1]Y
Type 3				[2]Y	[1]Y	[3]Y	[1]Y
Type 4					[1]Y	N	[4]Y
Great Plaza						[1]Y	N
Acropolis							[5]Y
Royal Courtyard							
Significance level: [1]< 0.0001 [2]0.0371 [3] 0.0098 [4]0.0003 [5]0.0015							

Accessibility of Site Types in Zone 5

The Kruskal-Wallis test suggests that significant differences exist in the access of site types in Zone 5, an ecologically diverse area in the western half of the valley. In contrast to all other zones, people living in this part of the valley were more integrated with individuals living at type 4 sites than with the monumental buildings and ceremonial spaces of the Great Plaza (Table 6.12). The Mann-Whitney test indicates significant differences exist in the accessibility of type 2, type 3, and type 4 sites, but not between type 1 and type 2 sites (Table 6.13). These results indicate that people living in this part of the valley had relatively equal access to type 1 and type 2 sites.

Table 6.12: *Kruskal-Wallis test: accessibility results for Zone 5*

Site Type	N (paths)	Integration Value
1	7053	11346
2	1756	11224
3	398	10361
4	255	**9344**
Great Plaza	107	9886
Acropolis	106	10916
Royal Courtyard	106	10839
p-value = <0.0001		

Table 6.13: ***Mann-Whitney test: accessibility results for Zone 5***

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		**N**	[1]**Y**	[2]**Y**	[3]**Y**	**N**	**N**
Type 2			[2]**Y**	[2]**Y**	[4]**Y**	**N**	**N**
Type 3				[5]**Y**	**N**	**N**	**N**
Type 4					[6]**Y**	[2]**Y**	[7]**Y**
Great Plaza						[8]**Y**	[9]**Y**
Acropolis							**N**
Royal Courtyard							
Significance level: [1]0.0005 [2]< 0.0001 [3]0.0125 [4]0. 0007 [5]0.0036 [6]0.0356 [7]0.0001 [8]0.0057 [9]0.0325							

The decreased access to Copán's civic-ceremonial center suggests that people living in the western half of the valley were less involved with the ruler and the royal court. These findings may result from the area's late occupation date during a time when population boomed and space near the city center was limited, or they may support the hypothesis that royal power was waning and becoming less centralized at the end of the eighth and early ninth centuries (W. Fash 1983a). The fact that type 4 sites were more accessible to people living in the western part of the valley than was the Principal Group may support the argument that nonroyal elite families were becoming more powerful during this time (B. Fash et al. 1992; W. Fash 2001; Stomper 2001). However, it does not necessarily negate the possibility that Ruler 16 had a hand in placing elites in locations that would allow them to wield authority on his behalf (Maca 2004; Plank 2003, 2004).

Summary of the Accessibility of Site Types for Physiographic Zones

With the exception of Zone 5, the results suggest that Copán was spatially organized to channel people living at all site types, in all zones, to the open spaces of the Great Plaza. Type 4 sites, presumably occupied by the elite, were the most integrated residential site type for all physiographic zones at Copán. The city's buildings and *sacbeob* seem to have been laid out to channel movement to elite compounds, increasing the frequency and intensity of interaction with elites. This access pattern is indicative of centralized power relations. In this case, the elite appear to have situated themselves within the landscape in such a way as to facilitate social control over people living in the valley (Gerstle 1987; Stuardo 2003).

Most archaeologists use the Harvard Site Typology criteria to designate type 3 and 4 sites as elite residents and type 1 and 2 sites as commoner dwellings. Given the assumed similarities between type 3 and type 4 sites, these sites would be expected to have similar integration values. However, the results indicate a marked difference in the integration values of type 3 and 4 sites. In all zones, the integration values of site types 2 and 3 are closer together than the integration values of type 3 and type 4 sites. Additionally, in Zones 3 and 4 there is no significant difference in the accessibility of site types 2 and 3. These access results highlight similarities between site types 2 and 3 that have not been observed in previous studies, suggesting that perhaps the occupants of site types 2 and 3 may have played similar economic, social, and/or political roles at Copán, or that the Harvard Typology has misclassified some of these sites. The next section investigates accessibility for the city's urban core and hinterlands in order to determine whether similar access patterns existed in these two areas.

Accessibility Results for Urban-Hinterland Interaction Spheres

Overall Accessibility

The Kruskal-Wallis test shows that sites in the urban core were much more highly integrated than those in the hinterlands (Table 6.14). In this case, it appears that settlement density may be a major factor driving the variation. As shown in Figure 6.3, the urban core had almost four times the settlement density of the hinterlands. Typically, the more crowded an area, the more likely people are to cross each other's paths, and therefore the more integrated the area. However, it is important to investigate whether particular site types also affected these integration values.

Table 6.14: *Kruskal-Wallis test: accessibility results for urban core-hinterlands*

Area	N (paths)	Integration Value
Urban Core	11294	4387
Hinterland	25199	7970
p-value = <0.0001		

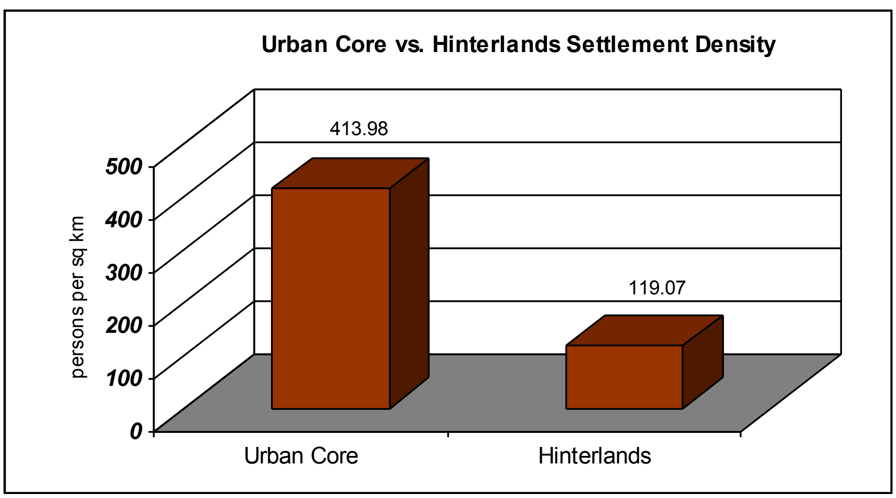


Figure 6.3: **Settlement density for urban core and hinterlands**

Integration of Site Types: Hinterlands

The Kruskal-Wallis test indicates that significant differences exist in the integration values of Copán's hinterland site types (Table 6.15). Like the valley-wide and physiographic zone results, these data support other results indicating that the Great Plaza was the most integrated site type in the valley. The access hierarchy of the hinterlands replicates the valley-wide results; that is, the Great Plaza is the most accessible location, and elite sites are more accessible than sites where commoners lived.

Table 6.15: ***Kruskal-Wallis test: accessibility of sites types for Copán's hinterlands***

Site Type	N (paths)	Integration Value
1	17990	8212
2	4497	7792
3	1022	7294
4	349	6967
Great Plaza	344	**5727**
Acropolis	349	6637
Royal Courtyard	348	6616
p-value = <0.0001		

The Mann-Whitney results suggest that the integration values for all site types in the hinterlands, except for site types 3 and 4, are significantly different (Table 6.16). Although the access hierarchies for the hinterlands and urban core are the same, the integration values for the two areas are markedly different as well.

Table 6.16*: Mann-Whitney test: accessibility results for site types in hinterlands*

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		**[1]Y**	**[1]Y**	**[1]Y**	**[1]Y**	**[1]Y**	**[1]Y**
Type 2			**[2]Y**	**[1]Y**	**Y**	**[3]Y**	**[1]Y**
Type 3				**N**	**[1]Y**	**N**	**[4]Y**
Type 4					**[5]Y**	**N**	**N**
Great Plaza						**[3]Y**	**[6]Y**
Acropolis							**N**
Royal Courtyard							
Significance level: [1]< 0.0001 [2]0.0053 [3]0.0003 [4]0.0022 [5]0.0002 [6]0.0465							

Integration of Site Types: Urban Core

The Kruskal-Wallis test indicates that significant differences also exist in the integration values of different site types in the urban core (Table 6.17). Although the Great Plaza was the most accessible location for both the hinterlands and the urban core, most likely due to the fact that it was in the most densely populated area in the center of the valley, there are several notable differences in the degrees of social connectivity between residential site types in the urban core and the hinterlands.

1. The cost of travel to any site type (1−4) was much lower for urban core residents than for those living in the hinterlands (Tables 6.15 and 6.17).

2. Unlike in the hinterlands, in the urban core the integration values for residential site types are all significantly different (Table 6.18).

3. It was significantly less costly to travel to type 4 sites than to type 3 sites from the urban core, while this difference was not statistically significant in the hinterlands.

4. In the urban core the integration values for site types 2 and 3 are more similar than they are for type 3 and type 4 sites.

5. In the urban core, the difference in cost between traveling type 1 sites and traveling to any other site type is much larger than it is in the hinterlands. For example, in the urban core the type 1 integration value is approximately 1700 units higher than the value for type 2 sites, whereas in the hinterlands the

value for type 1 sites is only about 300 units higher than for type 2 sites (Tables 6.15 and 6.17).

Table 6.17: ***Kruskal-Wallis test: accessibility of sites types for Copán's urban core***

Site Type	N (paths)	Integration Value
1	7900	5293
2	1968	3572
3	447	3312
4	276	2623
Great Plaza	268	**1847**
Acropolis	234	2604
Royal Courtyard	231	2476
p-value = <0.0001		

Table 6.18: ***Mann-Whitney test: accessibility results for site types in urban core***

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]**Y**	[1]**Y**	[1]**Y**	[1]**Y**	[1]**Y**	[1]**Y**
Type 2			[2]**Y**	[1]**Y**	[1]**Y**	[1]**Y**	[1]**Y**
Type 3				[1]**Y**	[1]**Y**	[3]**Y**	[1]**Y**
Type 4					[1]**Y**	**N**	**N**
Great Plaza						[1]**Y**	[1]**Y**
Acropolis							[4]**Y**
Royal Courtyard							
Significance level: [1]< 0.0001 [2]0.0034 [3]0. 0002 [4]0.0126							

Summary of Urban Core–Hinterlands Results

The integration results indicate that both the urban core and the hinterlands of Copán were configured to make travel easier to the Principal Group and elite compounds than to sites housing commoners. The elite living at type 4 sites, the most elaborate residential compounds, were most integrated, while individuals occupying type 1 sites, the simplest households, were the most segregated. These results suggest that accessibility may have served as a mechanism to lead people to Copán's civic-ceremonial center, as well as along paths passing by certain households so that the elite could evidence their power and wealth through their elaborate and grandiose architecture. Moreover, the high integration of elite sites most likely facilitated social interaction among the elite and other members of society, possibly serving as a mechanism of social control and indicating a level of subservience by the occupants of type 1 and 2 sites (Ferguson 1996; Hillier 1999; Hillier and Hanson 1994; Stuardo 2003).

Larger differences in the integration values (pathcosts) for residential site types (1−4) in the urban core than for those located in the hinterlands point to greater social segregation and social control in the central part of the site and less sociopolitical control outside of the city's center. These differences in cost may also reflect problems with the Harvard Site Typology. For example, although the difference between type 1 and type 2 integration values is striking in the urban core, it is much less marked in the hinterlands. These results suggest that people living at type 2 sites in the urban core were relatively integrated with society as a whole, yet people living at type 1 sites were not. In contrast, people living at both type 1 and type 2 sites in the hinterlands were more segregated. These differences suggest that people living at type 1 and type 2 sites in the urban core played distinctly different roles in Copaneco society but that this was not true of individuals living at the same site types in the hinterlands. These differences may point to social distinctions, for instance, farmers and servants, that are not accounted for in the Harvard Typology. The next section evaluates access patterns for Copán's *sian otots*.

Access Measurements for Sub-Communities

Overall Integration

The fourth and smallest scale of analysis provides measures of degrees of sub-community connectivity. People living in sub-communities with low integration values were connected to or had greater access to more people throughout the city than people living in sub-communities with high integration values. The goal of this section is to use the integration values to reconstruct patterns of connectivity, in order to better understand social interaction among Copán's *sian otots.*

The Kruskal-Wallis test indicates significant differences in the integration values of Copán's *sian otots*. Table 6.19 lists the sub-communities, from most accessible to least accessible. Measuring access at this smaller analytical scale detected some variation masked that is at larger scales. The results indicate that, as at larger scales, the Great Plaza was the most accessible location in the valley, but unlike patterns at larger scales, sites in Las Sepulturas were more accessible than the Royal Courtyard and Acropolis. In other words, it cost less for many pedestrians living in the valley to travel to Las Sepulturas than to enter the Acropolis or Royal Courtyard.

Taken together, these results support the scholarly belief that while commoners and elite alike had access to the Great Plaza, fewer people had access to the interior spaces of the Acropolis and Royal Courtyard. Moreover, the results point to routinized interaction between households in Las Sepulturas and people living in other parts of the valley. Perhaps commoners living at type 1 and 2 sites in the hinterlands, and even lesser elite living in these areas, did "business" with the Las Sepulturas elite. These elite may have served as liaisons to the king and/or had direct control over certain groups of people in the valley.

Table 6.19: *Kruskal-Wallis test: overall accessibility for Copán's* sian otots

Sian Otot	**N (paths)**	**Integration Value**	**Settlement Density**
Great Plaza	583	**3380**	N/A
Las Sepulturas	2361	**3967**	686.36
Royal Courtyard	583	**4025**	N/A
Acropolis	583	**4128**	N/A
Salamar	2344	**4271**	385.90
Chorro	1759	**4430**	377.42
Rastrojon	1758	**4723**	219.23
Comedero	1766	**5149**	274.42
Titichon	1761	**5209**	84.89
San Lucas	1778	**5453**	226.19
San Rafael	1767	**6109**	150.94
El Bosque	2361	**6119**	345.79
El Pueblo	1772	**6658**	52.75
El Puente	1185	**6871**	51.47
Yaragua	1178	**7548**	100.00
Mesa de Petapilla	2336	**7637**	179.79
Bolsa de Petapilla	1752	**9112**	89.42
Algodonal	1185	**10084**	96.36
Titoror	587	**10298**	63.16
Ostuman	2954	**10454**	151.52
Estanzuela	1779	**11437**	121.59
Rincon del Buey	1182	**13848**	82.28
Tapescos	1184	**15392**	116.44
p-value = <0.0001			

In general, the Great Plaza buildings have lower integration values than those in the Acropolis. The Great Plaza structures are in more public and open spaces to the north of the Acropolis, while those in the Acropolis are in relatively enclosed spaces on an artificially terraced plaza approximately 10 to 12 meters higher than the Principal Group's more northerly plazas. The area's limited entrances and height appear to be responsible for the decreased accessibility of the Acropolis.

Using the ArcGIS classification tool, I grouped the *sian otots* according to similar integration values (based on natural breaks). Figure 6.4 shows that in the grouping of contiguous *sian otots* people living in the easternmost area were more socially connected than those living in the western *sian otots*. A number of factors may contribute to this spatial pattern, including the longer occupation history and higher settlement density east of the city's center (W. Fash 1983a). It is difficult to test the impact of length of occupation without carrying out additional excavations. I tested the second possible factor using the Pearson Correlation test, which measures the degree of linear relationship between two variables, in this case, settlement density and integration. The resultant correlation coefficient of -0.566 (p-value is 0.009) indicates that that there is a slight negative correlation between the two variables, which means, generally speaking that as settlement density increases, integration values decreases. Figure 6.5 is a scatterplot illustrating the relationship. The results do not show a strong linear correlation.

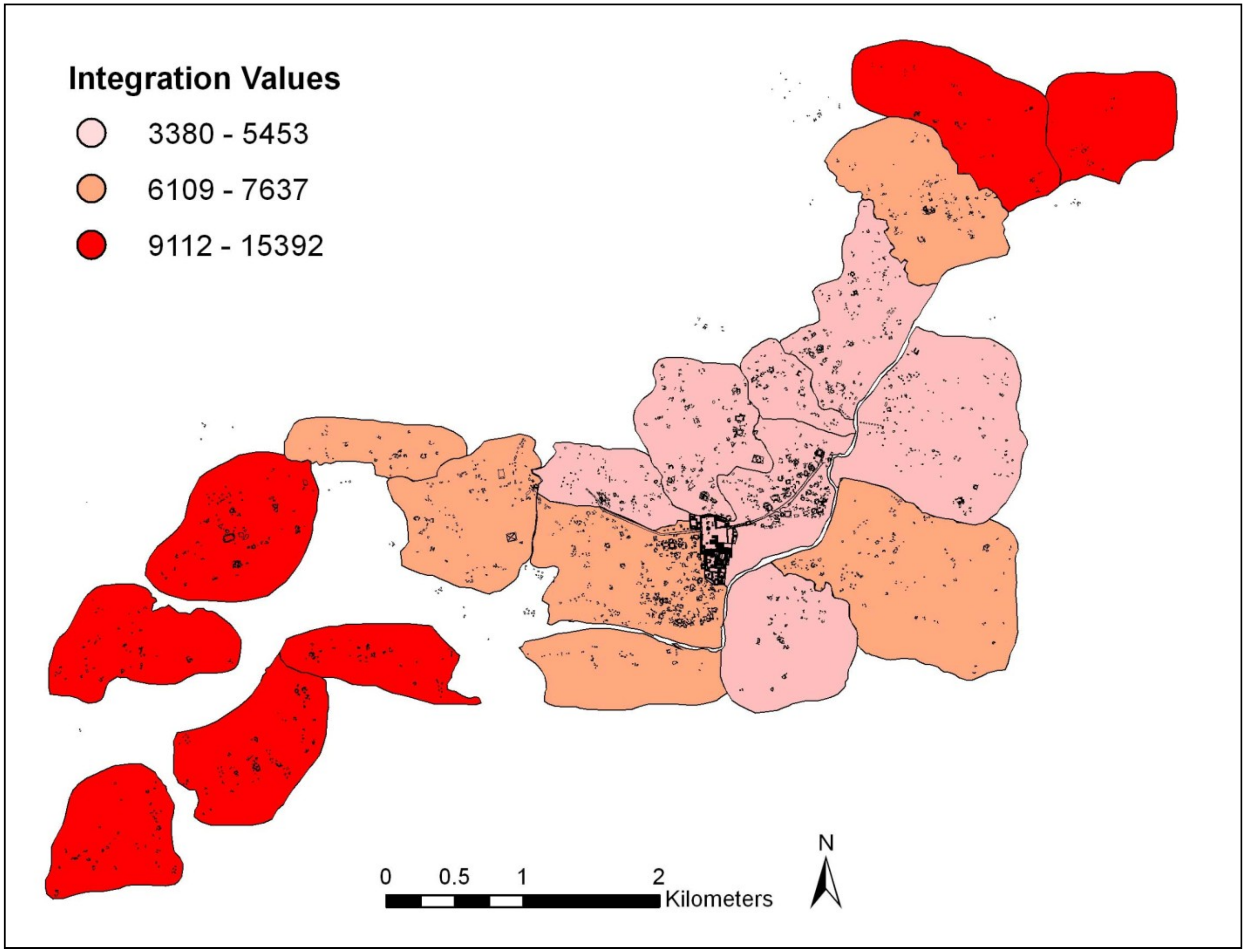


Figure 6.4: **Map showing *sian otots* classified according to similar integration values (based on natural breaks)**

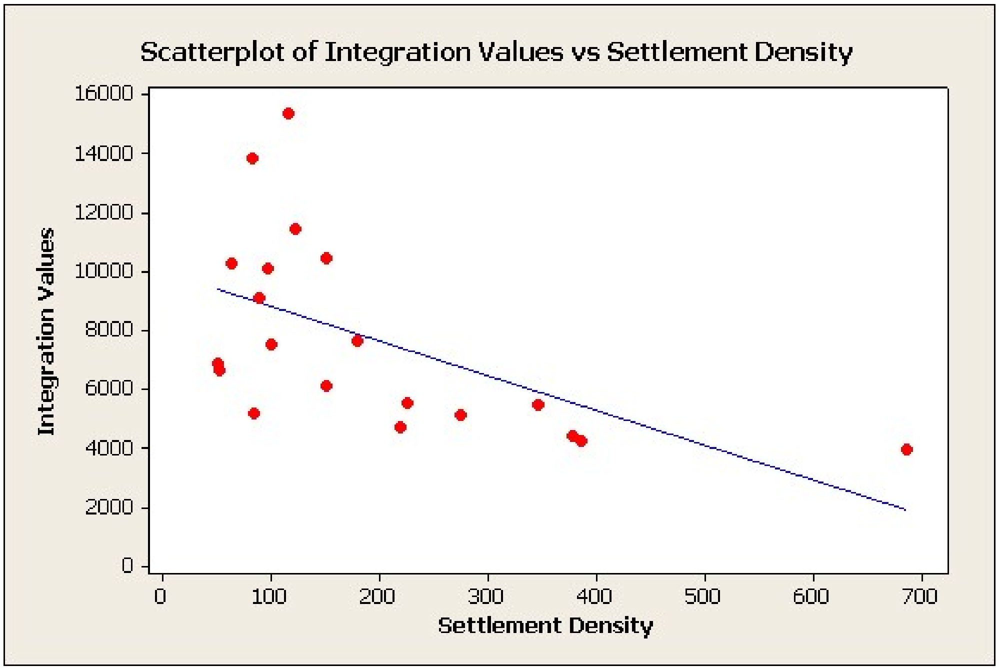


Figure 6.5: **Scatterplot of ranked settlement density vs. ranked tntegration values for *sian otots***

The scatterplot shows several *sian otots* that were not densely populated have relatively low integration values. For example, Titichon has one of the lowest settlement densities (84.89 persons per km^2), but its residents are highly connected to the rest of the valley (Figure 6.4, Table 6.19). Thus, while settlement density appears to explain some of the integration values that we see for the valley's *sian otots*, other factors may also influence the accessibility of Copán's sub-communities.

The results indicate that some *sian otots* with low integration values, such as Las Sepulturas, Salamar, and Comedero, were more integrated with society as a whole than some *sian otots* with high integration values, such as Tapescos and Rincon del Buey. Because it was much easier for residents living in sub-communities with low integration values to travel to other sites in the valley, they probably interacted with a greater number of people on a more regular basis than did people living in areas that were more difficult to access. Consequently, residents of highly accessible sub-communities were less socially segregated.

Access Measurements for Sub-Communities by Site Type

The aggregated integration values indicate that the Great Plaza was the most accessible sub-community in the valley, while Copán's most highly integrated residential sub-communities were those located in the northeast part of the valley (see Figure 6.4). These results, however, address the accessibility of each of the valley's four residential site types in relation to each of Copán's sub-communities. Although studying the internal access patterns of sub-communities could provide a wealth of information about social dynamicsm that level of analysis is beyond the scope of this dissertation, as the goal of the research is to identify potential patterns of communication among different social groups across the valley. Moreover, because many sub-communities do not have type 3 and type 4 sites—some even lack type 2 sites—I found it more useful to reconstruct access patterns among sub-communities rather than within them. Therefore, the patterns discussed below reflect the degree to which each sub-community could access certain site types, and not how accessible each site type was within each sub-community.

The discussion is organized into two parts. Part I focuses on Copán's residential sub-communities and is organized into three groups using patterns that emerge from the data. Because of the large amount of data, summary information is presented here; the Kruskal-Wallis and Mann-Whitney tables and descriptions of the sub-communities are provided in Appendix G. Part II examines the accessibility patterns for the Principal Group.

Part I: Accessibility for Residential Sub-Communities (*Sian Otots*)

The *sian otot* results underscore a major advantage of multi-scalar research—variation that is often masked at larger scales may be uncovered at smaller scales. The integration values listed in summary Tables G.1−G.38 in Appendix G indicate that many of Copán's sub-communities have access patterns that replicate the valley-wide, physiographic zone, and urban core−hinterland results in which the city's civic-ceremonial structures and elite sites were more accessible than sites where commoners lived. (The tables in the next section give the integration values for each residential site type, the Great Plaza, the Acropolis, and the Royal Courtyard; in each case the lowest integration value is highlighted in bold to emphasize the section's focus on residential sites.) The *sian otot* results show more diversity than those for the larger scales of analysis. The most obvious difference is that the Principal Group does not always have the lowest integration values. In fact, only eleven *sian otots* were most integrated with the Principal Group (Tables G.1–G.26). In five of the remaining *sian otots,* residents were most integrated with type 4 sites (Tables G.27–G.32), four *sian otots* were most integrated with type 3 sites (Tables G.33–G.38). This pattern is quite unlike the larger scales of analysis, in which the Principal Group always had the lowest integration value.

The data in Tables G.1–G.38 identify three access patterns that reflect spatial variation in the Copán Valley. From these patterns I hypothesize that the spatial variation may highlight (1) intermediate-level interaction spheres in the valley and/or (2) temporal, functional, ethnic, or other differences among the site types not accounted for in the Harvard Site Typology.

Residential Site Types

The Kruskal-Wallis test results indicate that people living in eighteen of the twenty residential *sian otots* experienced differential degrees of social connectivity with particular site types in the valley (Tables G.1−G.38). Three access patterns emerge from the data: Pattern A, 14 *sian otots*; Patterns B and C, three *sian otots* each. Figure 6.6 illustrates that these patterns are spatially influenced. Sub-communities that are most integrated with type 4 sites are in the central and western parts of the valley and those that are most integrated with type 3 sites are in the eastern part of the valley. These results may highlight intermediate interaction spheres controlled by two distinct social groups—one occupying wealthier and more elaborate type 4 sites, the other inhabiting smaller and less grandiose type 3 sites.

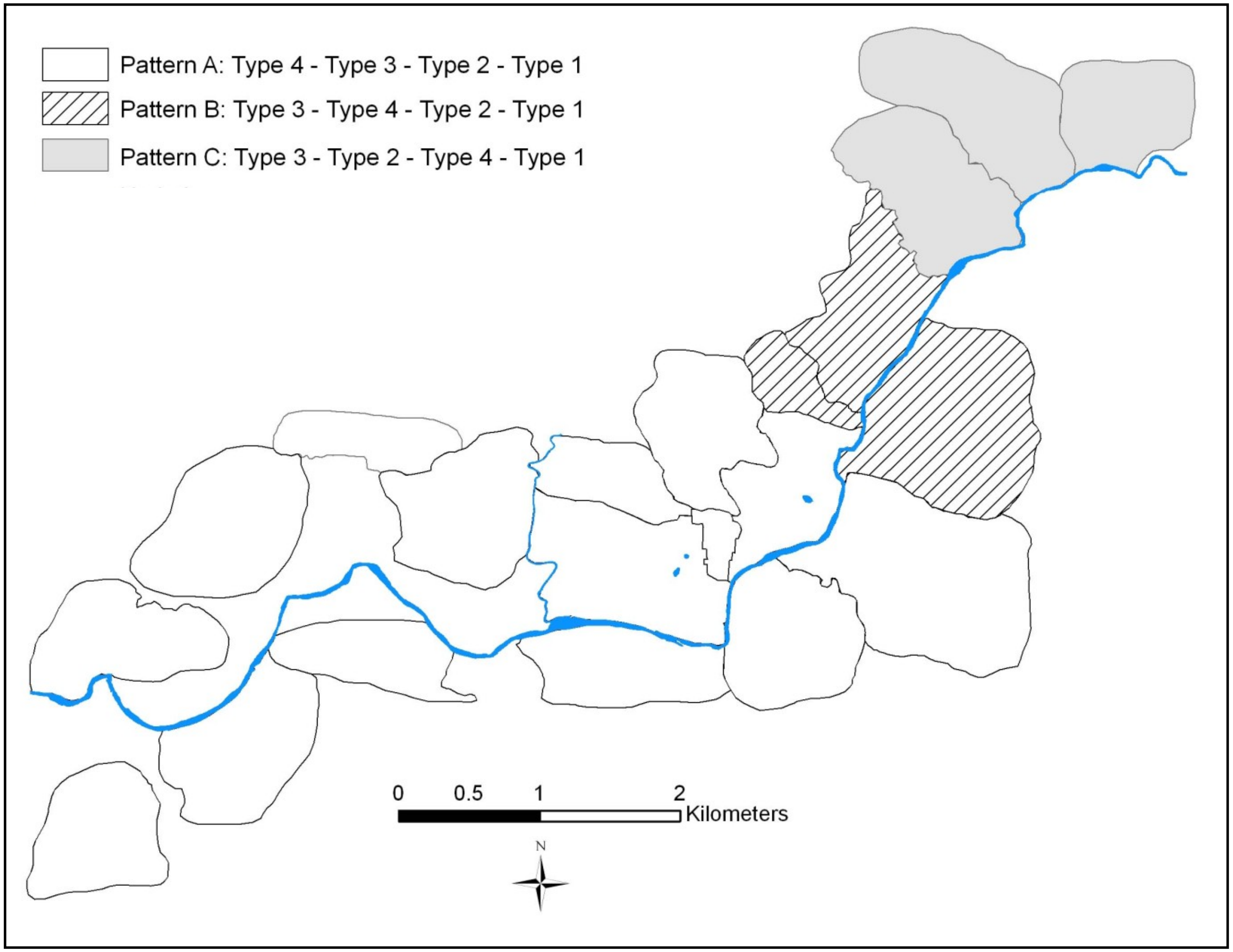


Figure 6.6: **Access patterns for site types 1–4 in Copán Valley based on *sian otot* integration values**

Summary of Pattern A Results

Examining the Mann-Whitney results (Appendix G), it is evident that although Pattern A sub-communities exhibit the same access pattern (type 4−type 3−type 2−type 1—from most to least integrated), there are overlapping sub-groupings among these fourteen sub-communities.

Observations:

1. Eight *sian otots* have no significant difference in the accessibility of type 3 and type 4 sites.
2. Twelve *sian otots* have no significant difference in the accessibility of type 2 and type 3 sites.
3. Five *sian otots* have no significant difference in the accessibility of type 1 and type 2 sites.

This patterning may indicate that: (1) people living in areas with significant differences in access among site types were more socially segregated, that is, social differences were accentuated through differential access; (2) people living in areas with little to no significant difference in access among site types were more socially integrated, that is, social differences were not as marked; and/or (3) there are problems with the Harvard Site Typology, and the lack of significant differences in some sub-communities may provide a place to begin to re-evaluate the typology.

Summary of Pattern B Results

Pattern B sub-communities exhibit an access pattern of type 3−type 4−type 3−type 1—from most to least integrated. The Mann-Whitney results indicate the following:

Observations:

1. All three sub-communities had significant differences between type 1 sites and all other residential site types.

2. None of the three sub-communities had significant differences between type 2 and type 4 sites and type 3 and type 4 sites.

3. Two sub-communities had no significant differences between type 2 and type 3 sites.

The relationships indicate that in sub-group B, people living at type 1 sites were more socially segregated than people living at other site types. Moreover, regardless of the fact that type 3 sites have the lowest integration values for these three sub-communities, these integration values are often not significantly different from type 2 and type 4 sites; therefore, the results suggest that (1) people living at type 2, type 3, and type 4 sites were similarly integrated, and/or (2) there are problems with the Harvard Site Typology. The "up" side to such incongruities is that lack of significant differences in integration values in some sub-communities may provide a direction for beginning to re-evaluate the typology.

Summary of Pattern C Results

Pattern C sub-communities exhibit a type 3−type 2−type 4−type 1 access pattern—from most to least integrated. Again, we see an example in which type 2 and 3 sites are more similar than type 3 and 4 sites. The Mann-Whitney results indicate that two of the three sub-communities had no significant differences between residential site types, which suggest that (1) there was less social segregation, social inequality, and/or less social control in these sub-communities than in other areas of the valley, and/or (2) there are problems with the Harvard Site Typology. As for Pattern B, the lack of significant differences between the integration values of some residential site types may provide a direction for beginning to re-evaluate the typology.

***Summary of Access Patterns for Residential Site Types in Copán's* Sian Otots**

Three access patterns emerge from the *sian otot* data that highlight possible spatial divisions in the valley (Figure 6.6). The Pattern A *sian otots* are in the western and central parts of the valley. The ancient Maya living in these sub-communities were most connected to the elite at type 4 sites and least connected to commoners living at type 1 sites. In contrast, people living in *sian otots* with Patterns B and C were more connected to type 3 sites than to type 4 sites.

Though some sub-communities were more connected to type 4 sites and others to type 3 sites, all sub-communities exhibited the greatest degree of connectivity to elite sites. These results suggest that the ancient Maya positioned their sites in the landscape to make it easier for people to access elite sites; in other words, they configured their surroundings to direct people toward elite households. Greater connectivity to elite sites probably indicates some degree of social control by the elite class and supports the hypothesis that the spatial organization of Copán formed an access hierarchy that helped to produce and reproduce its social structure on a daily basis. The question still remains, however, as to whether the spatial clustering in Figure 6.6 truly represents a spatial division in which the elite living at type 4 sites had more control in the western and central parts of valley and the elite living at type 3 sites have more control in the northeastern part, or if the apparent patterning actually highlights problems with the Harvard Site Typology.

If we assume that these results signify problems with the site typology, then perhaps an alternative way to identify intermediate spheres in the valley is to use the Mann-Whitney results. The urban core−hinterlands analysis indicated that the people living in the urban core experienced greater control over their movement with respect to channeling to specific site types than people living in the hinterlands; thus, it follows that there was greater sociopolitical control in the urban core. The *sian otot* analysis provides a more fine grained analysis that helps to identify differences within these two regions of differential degrees of social control that are masked at a larger scale.

Using the Mann-Whitney data I identified three categories (I, II, and III) based on the number of sites that have significant differences among their integration values that partition the valley into areas that may have experienced more or less social control (Figure 6.7). Category I sites exhibit significant differences among all site types except for one set (e.g., type 2 and 3 sites *or* type 3 and 4 sites), suggesting the greatest amount of social control. Category II sites exhibit significant differences among all site types except for two sets (e.g., type 2 and 3 sites *and* type 3 and 4 sites). Category III sites exhibit the fewest number of significant differences, with three or more site types not significantly different, suggesting the least amount of social control. Figure 6.7 illustrates that the ancient Maya living in the central part of the Copán Valley experienced the greatest social control, while those people living in the far western and northeastern regions experienced less sociopolitical control.

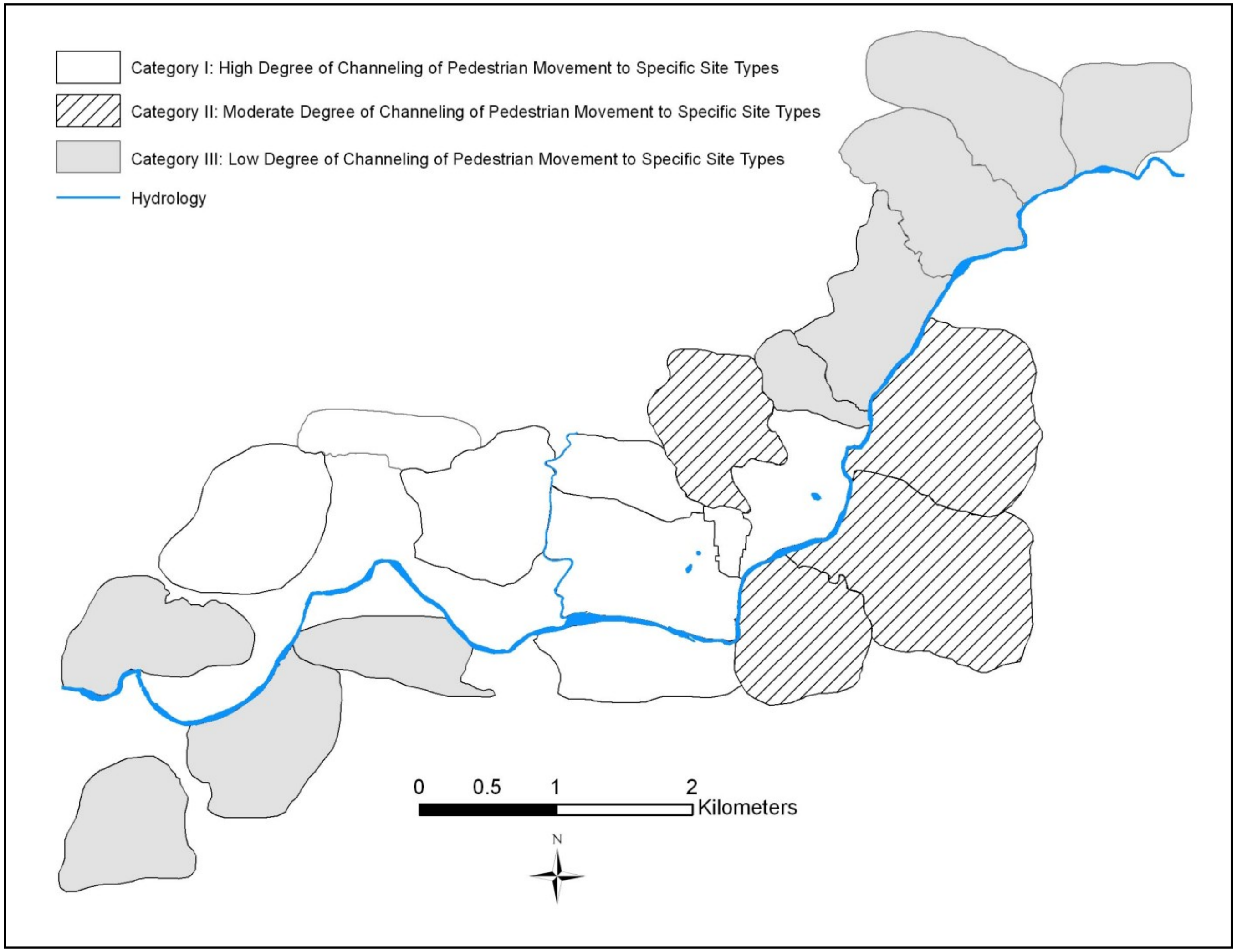


Figure 6.7: **Relative degree of control of pedestrian movement in Copán's *sian otots***

While the possibility of intermediate-level interaction spheres, defined by degree of sociopolitical control, is one possible explanation for differences in the statistical significance of accessibility among site types, two other explanations are possible. (1) The Harvard Site Typology is not accounting for spatial, temporal, functional, and/or ethnic variation in site types across the valley. (2) The results may reflect too small a sample size, that is, the number of sites analyzed for each *sian otot* is insufficient to identify statistically significant differences. Additional GIS analysis or test excavations are necessary to clarify the factors at work. The next section examines social connectivity between Copán's four residential site types (1−4) and the Principal Group to determine if people of distinct social classes were differentially channeled to the city's main civic-ceremonial center.

Part 2: Accessibility of Site Types to Principal Group Areas

The integration values listed in summary Tables 6.20–6.22 indicate the following pattern for the Great Plaza, Acropolis, and Royal Courtyard: Type 4–Type 3–Type 2−Type 1, from most to least accessible. These results support the assumption that at the valley-wide scale, elite groups were more integrated with the king and the royal court than were commoner groups.

Great Plaza

The Great Plaza constitutes the most public, open area of the Principal Group and comprises several ceremonial structures, including the site's main ball court and many freestanding monuments. Access measurements were taken from the center of the Great Plaza between the eastern and western *sacbeob*. The Kruskal-Wallis test suggests that people living at type 4 sites had the greatest access to the Great Plaza (Table 6.20). Interestingly, as at other scales of analysis, the integration values of type 2 and 3 sites are more similar than the values of type 3 and 4 sites. The notably high integration values for type 1 sites reinforce my earlier findings and indicate that individuals living at these sites were highly segregated from society as a whole.

Table 6.20: ***Kruskal-Wallis test: access results for sites in the Great Plaza***

Site Type	N (paths)	Integration Value
1	434	3987
2	107	2366
3	25	2080
4	16	**1569**
p-value = <0.0001		

Acropolis

The Acropolis comprises several tall ceremonial buildings occupying an elevated platform south of the Great Plaza. In general, this area appears much more restricted than the open spaces of the Great Plaza because of its steep vertical stairways and limited accessways. The Kruskal-Wallis test suggests that people living at type 4 sites had the greatest access to the Acropolis (Table 6.21). As for the Great Plaza, the Acropolis has integration values for type 2 and 3 sites that are more similar than the values of type 3 and 4 sites, and type 1 sites have markedly less access than the other site types.

Table 6.21: ***Kruskal-Wallis test: access results for sites in the Acropolis***

Site Type	N (paths)	Integration Value
1	434	4853
2	107	3003
3	25	2970
4	16	**2553**
p-value = <0.0001		

Royal Courtyard

The Royal Courtyard, believed to be Ruler 16's residence, borders the Acropolis to the south. It consists of elaborate structures on raised platforms, many with dressed stone (Andrews and Bill 2005). The Kruskal-Wallis test suggests that people living at type 4 sites had the greatest access to the Royal Court (Table 6.22). As for the Great Plaza and Acropolis, the integration values of type 2 and 3 sites are more similar than the values of type 3 and 4 sites, and type 1 sites have markedly less access than the other site types.

Table 6.22: ***Kruskal-Wallis test: access results for sites in the Royal Courtyard***

Site Type	N (paths)	Integration Value
1	433	4599
2	107	2917
3	25	2672
4	16	**2128**
p-value = <0.0001		

Summary of Principal Group Results

The access results support the assumption that Copán's elite were more connected to the city's major civic-ceremonial spaces and the king's private residence than were people living at commoner sites. Interestingly, the integration values for type 2 and type 3 sites are more similar than are the integration values for type 3 and type 4 sites. For example, the average integration values for site types 2−4 for the Great Plaza, Acropolis, and Royal Courtyard:

Type 2 sites = 2,762

Type 3 sites = 2,574

Type 4 sites = 2,083

These values suggest that commoners living at type 2 sites and elites living at type 3 sites had similar levels of access to the king and the city's royal spaces while the people living at type 3 and type 4 sites, both presumed to be elite groups, had much greater differences in access to these spaces. These results, combined with the fact that for many of Copán's residential *sian otots* significant differences did *not* exist in the integration values between type 2 and type 3 sites, provides another line of evidence that the Harvard Site Typology needs to be redefined to account for more social, functional, or other differences in ancient Maya society.

Significance of Results, Directions for Future Research, and Resulting Hypotheses

Valley-Wide

The valley-wide access results identify a pattern suggesting that the ancient Maya of Copán used accessibility to differentially channel pedestrians throughout the valley. In general, increased accessibility is correlated with increased social status, supporting the assumption that access served as a mechanism to help create and maintain distinct social categories. The city's layout seems to have served as a guide to daily interactions, facilitating pedestrian movement from across the valley toward the highly accessible main civic-ceremonial complex, the Principal Group.

The cost for people living at any site type to travel to the Great Plaza is lower than the cost to travel to any other site type in the valley. Scholars believe that the large, open spaces of the Great Plaza, lined with bleachers to seat thousands served as an arena for public events (W. Fash 2001). It appears that by channeling people from all walks of life to this area for events held among impressive architecture inscribed with imagery legitimizing the royal dynasty, Copán's 16th Ruler used the Great Plaza to help establish and maintain social cohesion among Copán's diverse social groups, which by the end of the Late Classic were dispersed throughout the valley.

As for residential sites, the elite living at type 4 sites appear to have situated themselves at strategic locations, making them the most socially connected social group by affording them the greatest access to all of the city's residents. Along these lines the city's configuration facilitated interaction between the residents of type 4 sites and the city's major civic-ceremonial complex, providing them greater access to the ruler, other members of the royal court, and the ritual ceremonies performed in the city center. Moreover, people living at type 3 sites were more integrated with society as a whole than were people living at type 2 and type 1 sites.

Despite the fact that many type 3 and 4 sites are aggregated in the city's urban core, the access patterns for type 3 and 4 sites suggest that the valley's elite still positioned themselves at locations on the landscape that were easily accessed (in terms of travel costs), and consequently would make them accessible to the greatest number of people. Previous studies show that people living at highly integrated locations can more easily exercise their authority as a result of their greater access to both people and resources and thus such a pattern suggests that the elite placed themselves on the landscape to help centralize their power, exercise control, and/or manage people and resources (Hillier 1996, 1999; Hillier and Hanson 1984).

Residents of type 1 sites constituted the least integrated social group, which suggests that the roles that they played in society did not necessitate a high degree of connectivity with people elsewhere in the valley. The results suggest that the majority of their interactions were at the local level, and that they were more socially isolated with respect to society as a whole. Such low degrees of social connectivity at the valley-wide scale suggest that the roles that residents of type 1 sites played in society did not require daily or even weekly communication with occupants living in other parts of the valley. Moreover, the fact that they were not as obviously channeled to particular sites suggests that perhaps they were a lesser target of social control, so ultimately their lower status may have provided them with more autonomy than other social groups at Copán.

Physiographic Zones

The access results for the physiographic zones suggest that more than ecological variables affect the integration values of particular site types in the valley. They show that, in some cases, zones with very different landforms and topography have similar integration values, while zones with similar landforms and topography often have very different integration values. A very interesting observation from the physiographic zone analysis is that Zone 5, located in the western part of the valley, was the least integrated area of the site (W. Fash 1983a). The cost to travel from Zone 5 to other parts of the valley was two to three times greater than it was for any other physiographic zone (Table 6.3).

What might Zone 5's low social connectivity reflect about Copán's sociopolitical organization? On the one hand, it may reflect less sociopolitical control on the part of Copán's ruling class in this part of the valley. Archaeological survey data suggest that Zone 5 had the shortest occupation history in the valley (most archaeological remains date only to the Middle Preclassic and Late Classic periods, with no intervening occupation) (W. Fash 1983a). Perhaps as Copán's 16th Ruler and other members of the elite groups experienced more difficulties in the later years of the Late Classic, they had less control over where people lived. Rather than continuing to be restricted to more highly centralized areas of the city, people may have enjoyed a new freedom to build in more distant locations. These decentralizing tendencies may reflect a loss of power for Copán's ruling authority (W. Fash 2001).

On the other hand, the lesser degree of social connectivity may simply be due to rapid Late Classic population growth, which would have required the occupation of more distant lands in the valley due to increasingly limited space in the urban core and the need for cultivating new agricultural lands to support the growing population and to counter loss of prime land converted to residential use in the urban core. Regardless of the causes, the access results indicate that people living in Zone 5 were more socially isolated from society as a whole than were people living in other zones.

Urban Core–Hinterlands

The access results for the urban core and hinterlands indicate that pedestrian movement was channeled toward elite compounds (type 3 and 4 sites) in both areas. This control of movement may have served as a showy display of elaborate architecture to evidence the power and wealth of the elites, or it may have served to facilitate social interaction between the elites and other members of society. Despite the fact that both urban and hinterland elite groups exhibited higher degrees of social connectivity than commoners, the large differences in the integration values for all residential site situated in the urban core, compared to those for hinterland sites, may indicate greater sociopolitical control in the urban core than in the hinterlands.

Archeological excavation and test units indicate that the urban core is the oldest and most continuously occupied part of the valley (W. Fash 1983a, 2001; Hall and Viel 2004; Sanders 1986). If these data are correct, then the access patterns indicate greater social control within the urban core and less social control within newer areas of Copán. Such findings may reflect a pattern of growth and development in which Copán's different site types may have been more equally dispersed across the landscape prior to the Late Classic. As the years passed, Copán's rulers and other elite may have intentionally aggregated their residences in the urban core, close to one another and to the royal precinct. This aggregation suggests the development of greater social inequalities between the elite and the commoners, reflected in the older areas of the site but less evident in the more recent parts of the site. While such a hypothesis is worth noting, it is difficult to test without additional excavation data.

Sub-Communities (Sian Otots)

The fourth and final scale of this multi-scalar approach focuses on Copán's sub-communities and identifies three spatial patterns that may possibly reflect intermediate-level interaction spheres at Copán. Figure 6.4 illustrates the first pattern. The map shows that *sian otots* in the eastern part of the valley were typically more integrated than those in the west. The east's greater accessibility may be attributed to its longer occupation history and higher settlement density, or it may reflect sociopolitical, economic, functional, or ethnic differences between the two ends of the valley.

Figure 6.7 illustrates a second pattern, which in actuality further subdivides the first pattern. It shows that the ancient Maya living in the central part of the Copán Valley experienced the greatest sociopolitical control while people living in the far western and eastern regions experienced less control. In areas with little or no significant differences between residential site types, there was likely less social segregation, social inequality, and/or less social control than in other areas of the valley, where there were significant differences in the access of different site types.

Figure 6.6 illustrates a third pattern. The map shows that type 4 sites were the most integrated site type in the western and central parts of the valley, whereas type 3 sites were the most integrated in the northeastern part of the valley. The results may indicate that the occupants of type 4 sites played a more important role in centralizing power in the western and central regions, while the residents of type 3 sites carried out a similar role in the northeast. However, given that significant differences in integration values were not found among site types in several *sian otots*, these results may (1) need to be further subdivided and/or (2) reflect problems with the Harvard Site Typology.

While these three patterns help to identify previously unobserved spatial variation in the valley, I contend that by carrying out an even finer grained analysis and examining the integration values of individual *sian otots* in relation to other settlement pattern data, smaller intermediate-level interaction spheres may be identified.

Two lines of evidence support the presence of intermediate-level spheres formed by several neighboring *sian otots* at Copán: (1) some *sian otots* had larger, more complex, and presumably wealthier sites than their neighbors; and (2) some *sian otots* had lower integration values, that is, they were more socially integrated, than their neighbors. The presence of large, complex sites with relatively high accessibility points to the presence of local seats of power in which community leaders living at these sites would have played an integral part in Copán's sociopolitical landscape by dealing with local problems and hosting community-level events (Leventhal 1979, 1981, 1983; Lucero 2007; Vogt 1969; Wisdom 1940). These same leaders may have served as intermediaries to the royal court.

For example, the presence of large, complex type 3 and type 4 sites with relatively low integration values (higher degrees of social connectivity) in the sub-communities of Ostuman and Estanzuela suggests that these two *sian otots* may have functioned as local seats of power in the western part of the valley, and therefore as intermediaries between the city center and other western *sian otots*. A similar system may have existed in the northeastern part of the valley. The low integration values of type 3 sites in this area suggest that some of these sites, possibly those located in Rastrojon and Mesa de Petapilla, also served as seats of power. However, given that the Mann-Whitney tests indicate that statistically significant differences do not exist in the accessibility of type 2 and type 3 sites in this part of the valley, I contend that some type 2 sites in this area may have functioned in a manner similar to type 3 sites. In fact, PAC I test excavations revealed "imposing" architecture, a relatively large number of ceramic fine wares, and dressed masonry (W. Fash 1983a:125) at Group 9P-5, a type 2 site in Titichon, suggesting that the site's occupants were wealthier than its type 2 classification suggests.

Such archaeological evidence is enticing and begs for excavation of specific type 2 sites in the northeastern part of the valley; however, it is also possible that the lack of statistical significance identified in the Mann-Whitney results is not simply indicative of problems with the Harvard Site Typology, but that these results actually provide information on the degree of social control across the Copán Valley. For example, *sian otots* that exhibit little or no significant differentiation in the accessibility of site types may have actually experienced less sociopolitical control than *sian otots* with significant differences among site types. In this interpretation, people living in sub-communities with relatively equal access to all site types would not have been channeled to particular site types whereas those living in sub-communities with highly differentiated access would have been. Previous studies indicate that greater control over pedestrian movement reflects increased sociopolitical control (Ferguson 1996; Hillier 1999; Hillier and Hanson 1984; Stuardo 2003), and thus people living in some areas of Copán appear to have been more tightly controlled than those living in other areas. Given these findings, it would be interesting to compare archaeological materials (e.g., burial patterns, ceramic types, etc.) from sites that appear to have been under more or less social control.

Taken together, the access patterns for all four scales of analysis lead to six general conclusions:

1. The Great Plaza was the most accessible location in the valley.
2. At the smaller scale, Las Sepulturas was more accessible than the Royal Courtyard and Acropolis, that is, it cost less for many pedestrians living in the valley to travel to Las Sepulturas than to enter the Acropolis or Royal Courtyard.
3. Elites living at type 4 sites were the most connected to the Principal Group.
4. Site organization directs people to elite households, reflecting greater social connectivity with elites than with commoners.
5. Different degrees of social control exist for various parts of the valley.
6. The similarities between type 2 and type 3 sites point to potential problems with the Harvard Site Typology.

Of these six conclusions, the similarities between type 2 and type 3 sites may have the most important implications for studying sociopolitical organization at Copán.

Because the Harvard Site Typology assumes that residential function and site type are correlated to socioeconomic status (Webster et al. 2000; Willey et al. 1978), it may fail to account for temporal, functional, social, economic, and/or ethnic differences. While archaeological excavations typically support the assumption that people living at type 3 and 4 sites were wealthier than those living at type 1 sites (W. Fash 1989; Freter 1994; Webster and Gonlin 1988), the wealth differences between type 2 and 3 sites are not always so clear (W. Fash 1983a; Webster et al. 2000). Webster et al. (2000:68) report that, "some Type 2 buildings have finely cut stone and vaulted roofs," which are traits reserved for type 3 and 4 sites.

Moreover, archaeologists suspect that not all sites beyond the Principal Group were strictly residential. Excavation data suggest that such places more than likely were multi-functional, serving as dwellings, shrines, and perhaps community meeting houses (Ashmore 1991; Hendon 1987; Leventhal 1979, 1983). This is not to say that sufficient data to determine social class or site function does not exist for excavated sites in the urban core suburbs of Las Sepulturas, El Bosque, and Comedero (W. Fash 1989; Hendon 1987, 1991; Maca 2002; Manahan 2003, 2004; Sanders 1989; Webster 1989)—in fact, they do, and they provide an abundance of information about Copán that is typically not available for other Maya sites. However, only a small percentage of type 2 and 3 sites have been excavated outside the urban core; thus, more excavations are required.

While scholars have discussed the relative accessibility of spaces within Copán's major civic-ceremonial group (e.g., Baudez 1994; Sanchez 1997), this research is the first to actually quantitatively measure access to this area. It is also the first study to investigate accessibility at multiple scales, integrating both the natural and built environments to study interaction among people living at different site types in the Copán Valley. The next chapter investigates visibility patterns for different parts of the valley and among different site types in order to further study social connectivity at Copán.

Chapter 7:

Visibility Analysis

Visual connections facilitate communication flow by allowing for messages to be transmitted from senders, or *addressers*, to receivers, or *addressees* (Goffman 1983; Jakobson 1980; Llobera 2001, 2006) and thus, like accessibility, provide insight into social connectivity. Research questions addressed included: *Was the king, via Principal Group structures and the Royal Courtyard, more visually connected to elites or commoners? Did differences in the visibility of site types exist at different locations in the valley?* The answers to such questions and others of a similar vein help to reconstruct social ties and to better understand sociopolitical organization at ancient Copán.

The findings indicate that some of the variation in the visibility of different site types is masked at the valley-wide scale, while smaller, more fine grained scales of analysis can reveal distinct differences in visibility in different areas of the site as well as among different social groups. While the differences in visibility between type 5 sites and site types (1−4) are statistically significant, the differences in visibility among site types 1−4 is not always statistically significant. However, given that three of the four analytical scales exhibit patterns that replicate the findings in the access study, I contend that the visibility data are nevertheless useful in identifying and understanding relationships among people living at different site types and in different areas of Copán.

The visibility results indicate that while the Principal Group was the most visible location in the valley, Copán's ruler disproportionately targeted the elite. While at the valley-wide scale there appears to have been a visual hierarchy in which elite complexes were more visually prominent than commoner households, the data for the urban core and hinterlands uncover variation within the valley that is masked at this largest scale of analysis. The data indicate that while in the urban core elite complexes were more visually prominent than commoner households, the reverse pattern existed in the hinterlands, that is, commoner households were more visually prominent than elite complexes. The sub-community data (an even smaller analytical scale) further refine this pattern by subdividing the hinterland results. These data indicate that commoner households were more visible in the western hinterlands, while elite complexes were more visible in the eastern hinterlands. The result is a west-east spatial division in the valley, marked by less sociopolitical control in the west that replicates the access study results.

Ultimately, the visibility data offer useful information about the different roles visibility may have played in structuring social interaction among people living at different site types. In instances where the data diverge from identified patterns, I contend that they provide information on (1) possible differences in site function, (2) directions for refining the Harvard Typology, and (3) ways to improve the methods used in this study.

Visibility Data

The Urban DEM served as the root file to create the viewsheds and derive the visibility data (see Appendix E for a list of sites and buildings).The visibility analysis included 67 residential sites (derived from the 74 sites used in the access study), seven Principal Group buildings, and the Royal Courtyard. I used the viewsheds to perform two types of analysis. First, I calculated the overall visual prominence of Copán's different site types in order to determine which site type was most visible at each of the four scales of analysis (see Appendix H for viewsheds). Second, I quantified the visual connectedness between people living in distinct areas of the valley and at different site types. By comparing the number of visible architectural groups to non-visible groups, I calculated the percentage of visibility for each site type at four analytical scales: valley-wide, physiographic zones, urban core−hinterlands, and *sian otots* (see Chapter 5 for methodology).

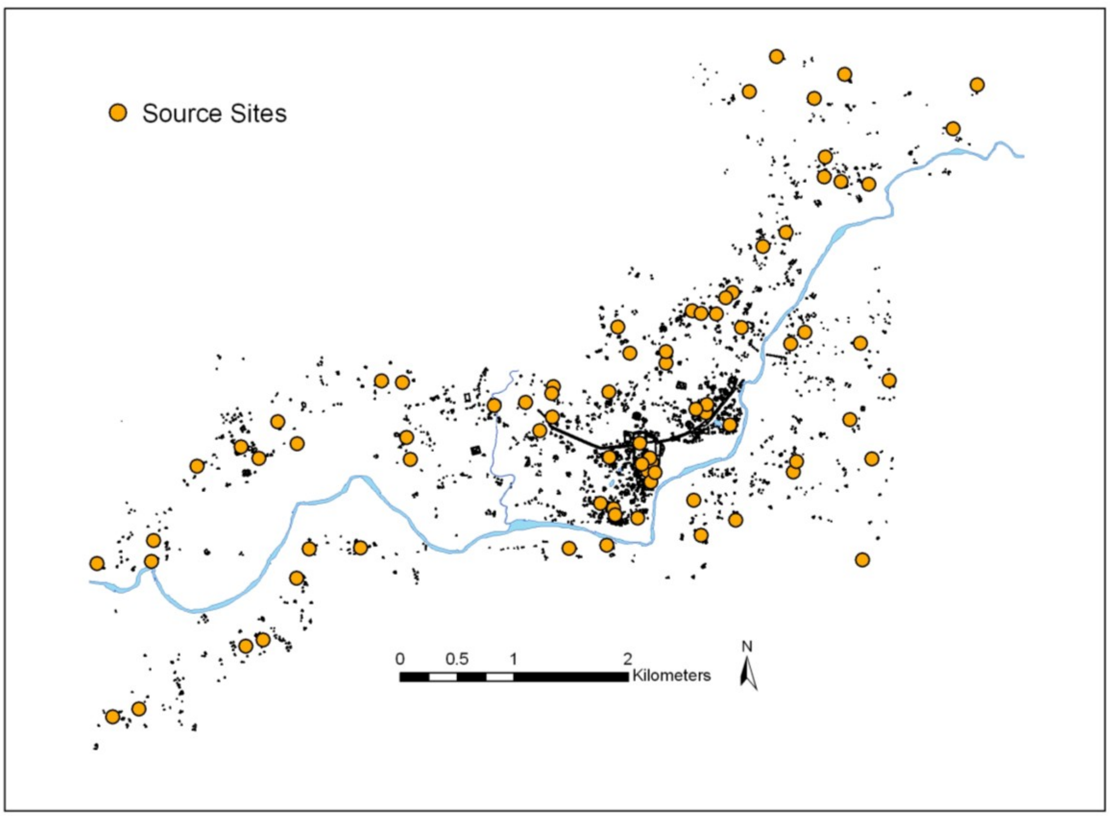


Figure 7.1: **Source sites for visibility analysis**

The process of using the viewsheds to quantify the visual prominence and visual connectedness of certain locations and specific site types was a two-step procedure. First, I measured visual prominence. Sites with low visual prominence could see and be seen from the fewest number of structures (low visibility), whereas sites with high visual prominence (high visibility) could see and be seen from the greatest number of structures (Llobera 2003, 2006; Ratti 2005; Wheatley and Gillings 2001). After calculating the visual prominence of the 75 sample sites, I used the data to quantify the visual connectedness among people living at different site types. To carry out this step, I took advantage of the unique capabilities of GIS to extract visibility data for all five site types. I then used the visibility values of each sites type to determine whether people living at a one site type could see a larger or smaller percentage of households belonging to a other site types. For example, were people living at type 4 sites more visually connected to people living at type 3 sites than to the occupants of type 1 or 2 sites?

Since there is only one type 5 site, the Principal Group, I generated viewsheds for seven individual buildings located in this main civic-ceremonial complex: Str. 10L-4, Str. 10L-11, Str. 10L-16, 10L-18, Str. 10L-21, Str. 10L-22, and Str. 10L-26 (Figure 7.2) (see Appendix H for viewsheds). Using the *Map Algebra* tool in ArcGIS, I added the viewsheds together to create a cumulative viewshed that highlighted areas of visual overlap for these six structures. With this method, instead of carrying out the visibility analysis using a sample of source sites as was required for site types 1−4, I was able to measure the visual connectedness between the Principal Group and all five valley sites. The data and results are presented according to analytical scale, from valley-wide to *sian otots*.

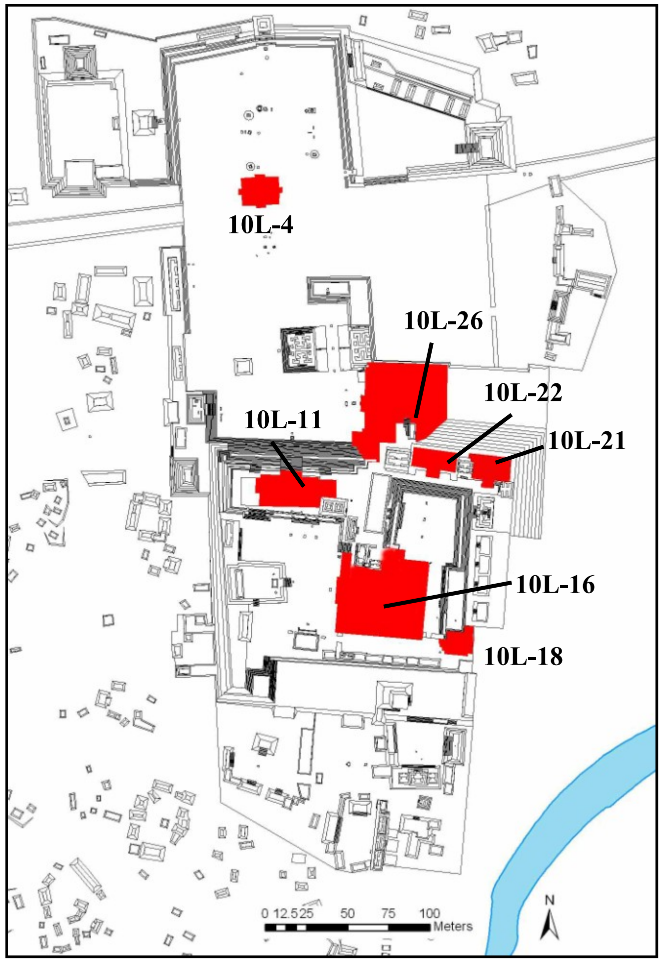


Figure 7.2: **Principal Group structures used in visibility analysis**

Visibility at the Valley-Wide Scale

Visual Prominence

The valley-wide data tested two assumptions:

1. Given that type 5 sites represent the very tall ceremonial structures of the Acropolis, it is expected that they will have higher visibility than all other site types.

2. Given that type 3 and type 4 sites are categorized as elite and are on average 1.1−1.4 meters higher than type 1 and 2 sites, it is expected that they will have higher visibility than type 1 and 2 sites (Table 7.1).

Table 7.1: ***Average heights for site types 1−4 (heights include platforms and superstructures).***
See Appendix B for original data from which averages were calculated.

Site Type	Avg. Height (m)
1	3.71
2	4.23
3	5.32
4	5.60

Table 7.2: ***Kruskal-Wallis test: valley-wide visibility results for all site types***

Site Type	Visibility Value
1	0.351
2	0.404
3	0.400
4	0.467
5	0.759
p-value = 0.008	

Although the Kruskal-Wallis Test suggests that significant differences exist in the visual prominence of Copán's different site types (Table 7.2), the Mann-Whitney results in Table 7.3 show that statistically significant differences exist only for the city's main civic-ceremonial structures (type 5). (For the Mann-Whitney results, *Y* indicates statistical significance and *N* means no statistical significance). Despite the fact that significant differences do not exist in the visual prominence of Copán's residential site types 1−4, the visibility values listed in Table 7.2 provide useful comparative information about differences in the visual prominence of different site types within the valley and ultimately may help to identify some possible relationships among social groups at Copán.

Table 7.3: ***Mann-Whitney test: valley-wide visibility results for all site types***

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		**N**	**N**	**N**	[1]**Y**
Type 2			**N**	**N**	[1]**Y**
Type 3					[1]**Y**
Type 4					[1]**Y**
Type 5					
Significance level: [1]< 0.0001					

The visibility values in Table 7.2 support assumption 1 that the site's main ceremonial structures (type 5) were the most visually prominent features in the valley. The visibility values do not however support assumption 2. As expected, type 1 sites were the least visually prominent. While, as expected, type 4 sites were the most visible residential site type, type 3 sites did not have higher visibility values than type 2 sites. In fact, with a minimal difference of 0.004, the visual prominence for type 2 and 3 sites is basically identical—a pattern of similarity also identified in the integration analysis presented in Chapter 6. The lack of significant differences between type 2 and type 3 sites may suggest one or more of the following: (1) variation in visibility between distinct site types is masked at the valley-wide scale, (2) some of the type 2 and type 3 sites are misclassified, and (3) building location plays a greater role than building height in influencing site visibility. The data and results from the smaller analytical scales allow exploration of each of these possibilities.

Visual Connectedness

While data on visual prominence provide information on overall site visibility, it is also important to investigate intervisibility among site types in order to study visual connectedness among people living at different site types in the valley. The Kruskal-

Wallis test indicates a lack of statistically significant differences in the visual connectedness of residential site types in the valley (p-values are all greater than 0.05); nevertheless, the visibility values in Tables 7.4–7.7 highlight patterns in the data. The visibility values in the tables are read as percentages of visible sites. For example, in Table 7.4 the visibility values indicate that 25.6% of people living at type 1 sites could see other type 1 sites, 28.2% could see type 2 sites, 32% could see type 3 sites, and 33.3% could see type 4 sites. The data also show that 55.4% of people living at type 1 sites could see the Principal Group.

Type 1 Sites

Table 7.4*: Kruskal-Wallis test: valley-wide visibility results for type 1 sites*

Site Type	Visibility Value
1	0.256
2	0.282
3	0.320
4	0.333
5	**0.554**
p-value = 0.609	

Type 2 Sites

Table 7.5: ***Kruskal-Wallis test: valley-wide visibility results for type 2 sites***

Site Type	Visibility Value
1	0.376
2	0.440
3	0.480
4	0.483
5	**0.750**
p-value = 0.324	

Type 3 Sites

Table 7.6: ***Kruskal-Wallis test: valley-wide visibility results for type 3 sites***

Site Type	Visibility Value
1	0.371
2	0.447
3	0.480
4	0.567
5	**0.875**
p-value = 0.194	

Type 4 Sites

Table 7.7: ***Kruskal-Wallis test: valley-wide visibility results for type 4 sites***

Site Type	Visibility Value
1	0.392
2	0.531
3	0.520
4	0.500
5	**0.875**

Observations on Principal Group:

1. Ancient Copanecos, independent of site type, exhibited the greatest degree of visual connectedness with the Principal Group (type 5 site).

2. 87.5% of those living at type 3 and type 4 sites, presumably elites, were visually connected to the Principal Group (Figure 7.3).

3. 75% of people living at type 2 sites, presumably commoners, could see the Principal Group

4. 55.5% of people living at type 1 sites, presumably commoners, were visually connected to the Principal Group

5. When the data for type 1 and 2 sites are aggregated, they indicate that 59.5% of commoners (people living at type 1 and type 2 sites) were visually connected to the Principal Group (Figure 7.4).

The data in Tables 7.4−7.7 indicate that while it was important to Copán's rulers that the city's major civic-ceremonial monuments be highly visible, they disproportionately targeted the city's elite in planning the site: nearly 90% of elites could see the Principal Group, in contrast to only 60% of commoners. Several explanations are possible for this phenomenon. First, the royal dynasty intentionally sent daily messages via the visibility of their massive monuments to other elite to remind them of the power and legitimacy of the rulers. Second, rulers used the Principal Group monuments to establish visual links between the royal court and other elite in order to help maintain social cohesion among Copán's dominant class(es). This line of thought follows Nicholas Abercrombie, and Stephen Hill, and Bryan Turner's (1984) concept of the dominant ideology as a means of uniting the elite rather than appease the commoners. Third, the elite residents of type 3 and 4 sites chose to place their residences in locations of local prominence that visually connected them to the Principal Group. The findings also highlight marked differences in the percentages of people living at type 1 and 2 sites (75% vs. 55.5%, respectively) who could see the Principal Group. This is a second line of evidence in the visibility data that some type 2 groups may be misclassified in the Harvard Typology. Another interpretation is that a more definitive distinction needs to be made between commoners living at type 1 and type 2 sites.

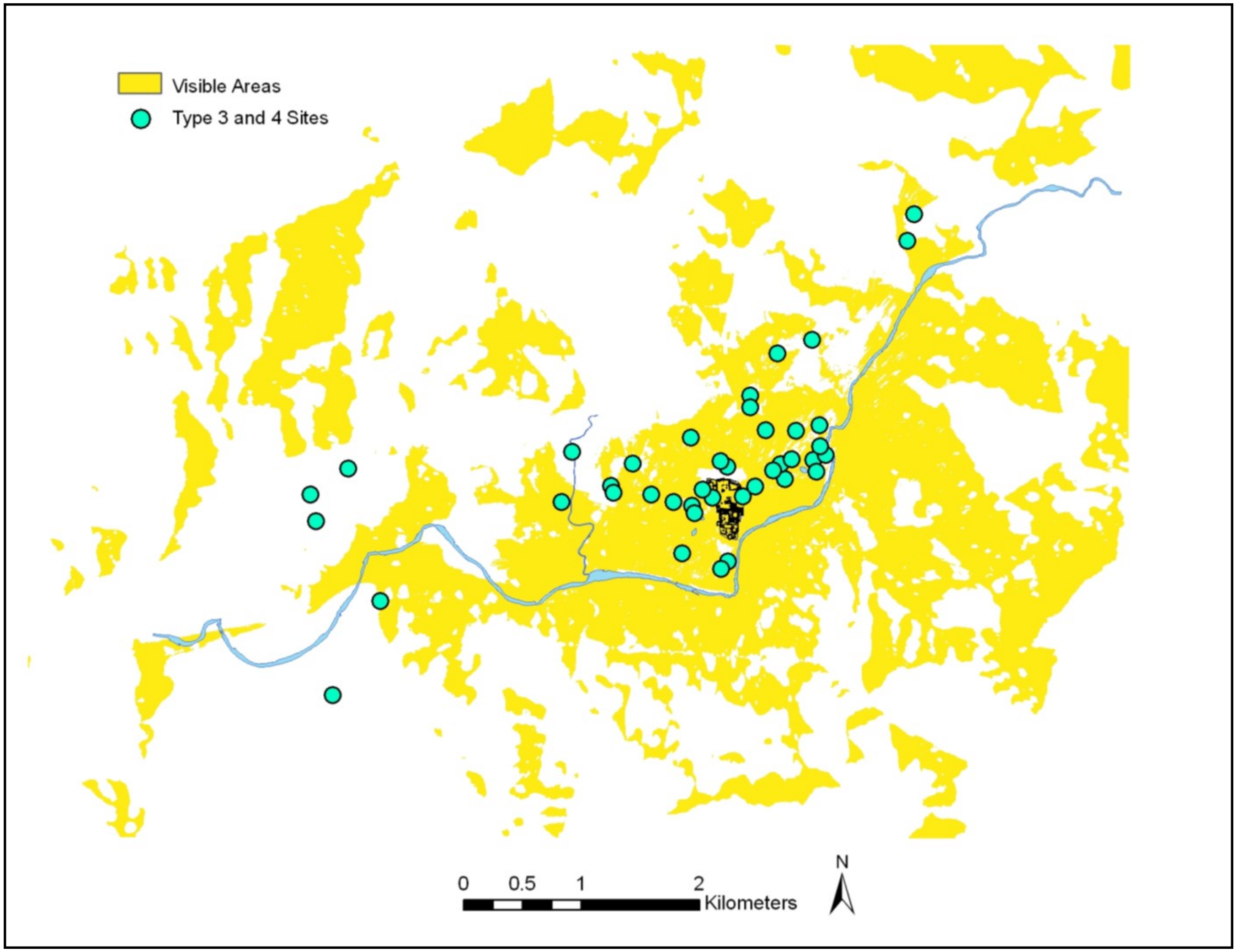


Figure 7.3: **Viewshed illustrating that 87.5% of elite sites in Copán Valley were visually connected to the Principal Group**

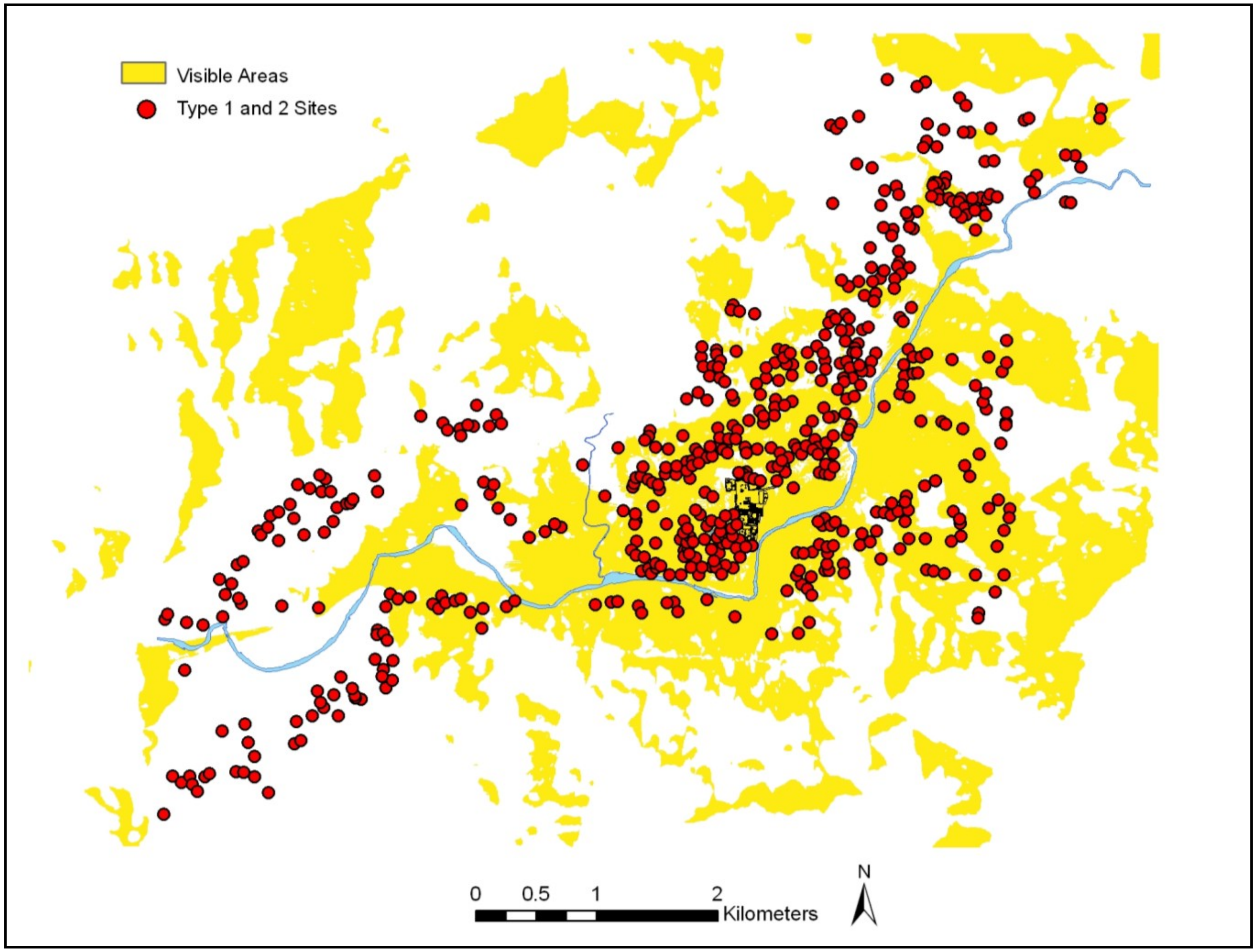


Figure 7.4: **Viewshed illustrating that 59.5% of commoner sites in Copán Valley were visually connected to the Principal Group**

Observations on residential site types:

1. Site types 1, 2, and 3 were most visually connected to type 4 sites.
2. People living at type 4 sites were most visually connected to type 2 sites.
3. The residents of type 1 sites were the least visually connected to all site types.

Given that more residential sites were visually connected to type 4 sites than any other site type, the patterns of visual connections may reflect a need for increased communication between the residents of type 4 sites and most sectors of society, and/or they may reflect some sort of elaborate and conspicuous power play by type 4 occupants. Interestingly, the elite living at type 4 sites were more visually connected to individuals living at type 2 and type 3 sites than they were to other elite living at type 4 sites. These results suggest that it was more important for the elite living at type 4 sites to communicate visual messages to people of other social groups than to maintain visual connections with people presumably from their own social class. In general, the valley-wide visibility patterns support my assumption that people of higher social status seek to be more visible than those below them in the social hierarchy. A possible explanation for this pattern may be that high visibility on earth represents an elevated position or status in the cosmic order (Houston et al. 2006).

Visibility of Physiographic Zones

Visual Prominence

The Kruskal-Wallis results shown in Table 7.8 indicate that significant differences existed in the visual prominence of sites located in different physiographic zones (see Figure 2.4 for map of zones). The Mann-Whitney test confirms that significant differences existed between all zones except for Zones 2 and 4 (Table 7.9).

Table 7.8: ***Kruskal-Wallis test: overall visibility results for physiographic zones***

Zone	Visibility Value
2	0.552
3	0.386
4	**0.674**
5	0.057
p-value = <0.0001	

Table 7.9*:* ***Mann-Whitney test: overall visibility results for physiographic zones***

	Zone 2	Zone 3	Zone 4	Zone 5
Zone 2		[1]Y	N	[1]Y
Zone 3			[1]Y	[1]Y
Zone 4				[1]Y
Zone 5				
Significance level: [1]< 0.0001				

Observations on physiographic zones:

Sites in Zone 2, a low river terrace in the center of the valley, and Zone 4, the foothills and high and low river terraces south of the river, were the most visually prominent sites in the Copán Valley.

1. The visual prominence of sites in Zone 3, the foothills north of the river, falls between the values for Zones 2 and 4, and Zone 5.

2. Sites in Zone 5, an ecologically diverse zone in the western half of the valley, had very low visual prominence.

By comparing these observations to the physiographic descriptions for each of the zones, it becomes clear that ecological variables are not solely responsible for these patterns of visual prominence in the Copán Valley. Zone 2 is in the central part of the valley and most sites are positioned on the low terrace of the Río Copán between 580-590 masl (meters above sea level). In contrast, most Zone 4 sites are on the high river terrace and in the foothills between 600-700 masl (Figure 7.5). However, despite these very different landforms and elevations, Zones 2 and 4 do not have significantly different visibility values.

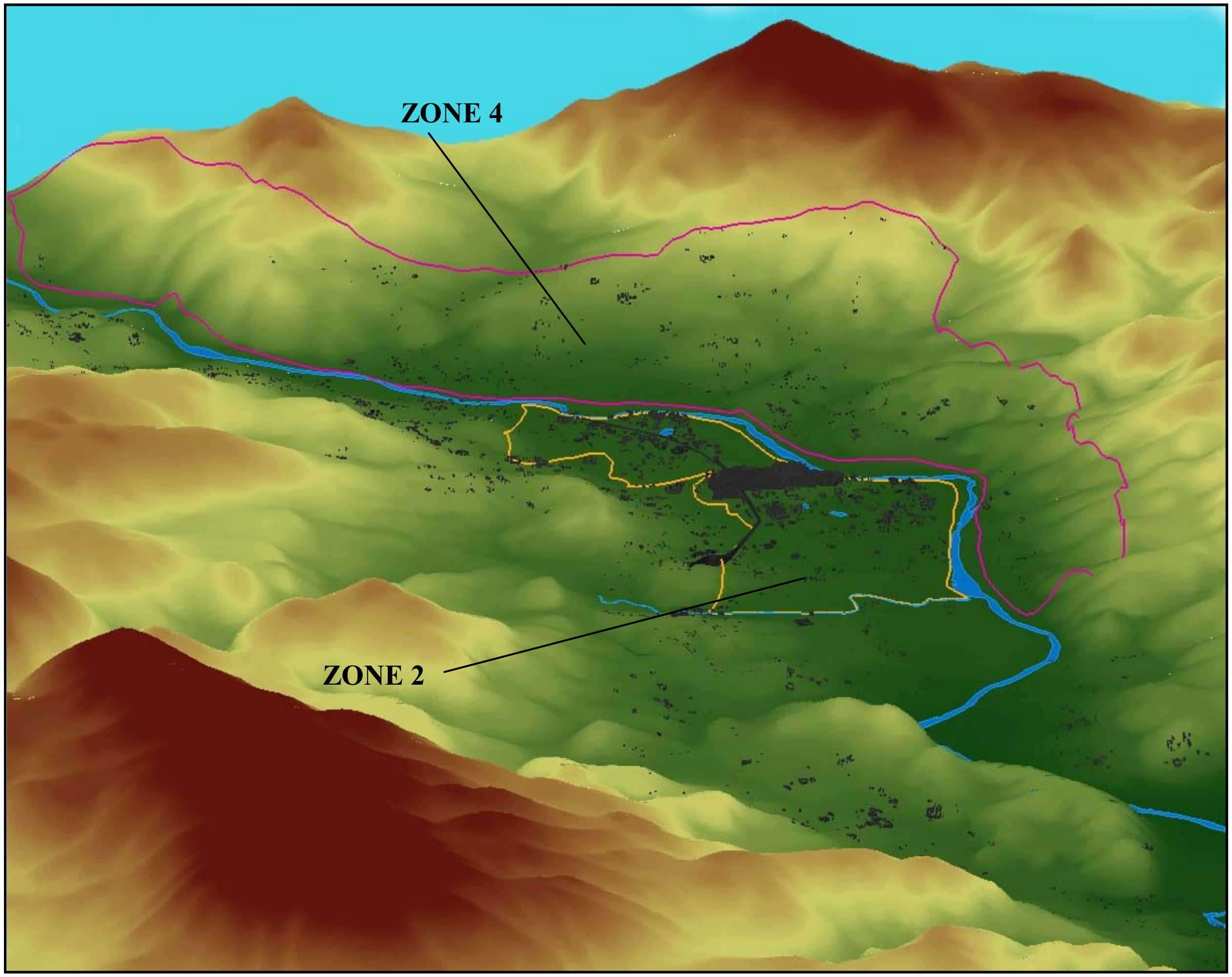


Figure 7.5: **3D visualization comparing Zone 2 and Zone 4 topography**

Furthermore, Zone 5, with the lowest visibility, is the most ecologically diverse area of Copán consisting of floodplains, high river terraces, and foothills, suggesting that a single landform type is not responsible for visibility. *Why, then, such low visual prominence for sites located in Zone 5?*

Current archaeological evidence suggests that Zone 5 had the shortest and most punctuated occupation sequence, with habitation only in the Middle Preclassic and Late Classic periods (W. Fash 1983a). Archaeologists also believe that Zone 5 contained many of the valley's prime agricultural lands, at least in the Late Classic period (W. Fash 1983a; Leventhal 1979). These two factors may account for the area's low settlement density (115.10 structures/km^2), which in turn may contribute to the low visual prominence of the zone's sites. The visibility data for Zone 5 raise the question: *Does lower settlement density correlate to lower visual prominence in the Copán Valley?*

I employed the Pearson correlation test to evaluate whether there is a correlation between the variables of visual prominence and settlement density for Copán's physiographic zones. The correlation coefficient is 0.369 with a p-value of 0.631. Because the p-value is greater than 0.05, there is not a correlation between visual prominence and settlement density; however, these results may be somewhat misleading. The scatterplot in Figure 7.6 illustrates that while settlement density may not explain the high visibility of sites in Zone 4, it most likely explains, at least in part, the relative visual prominence of sites located in Zones 2, 3, and 5. For example, Zone 2 has high visual prominence and high settlement density and Zone 5 has low visual prominence and low settlement density.

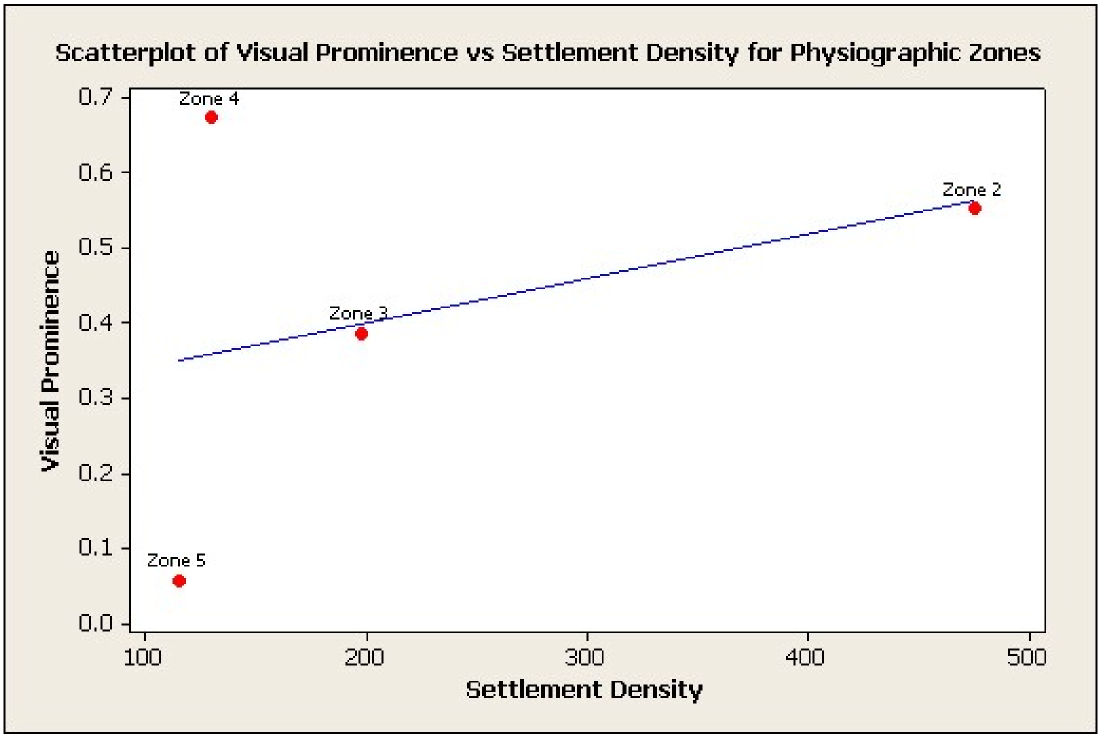


Figure 7.6: **Scatterplot of visual prominence vs. settlement density of physiographic zones**

The high visibility of sites in Zone 4 may simply be due to the area's steep slopes, which permit sweeping views from the valley below. Altogether, the results emphasize that a multitude of factors, such as building height, landform, elevation, and settlement density, affected visual prominence. In order to better understand how these factors influenced visual connectedness among specific social groups, the visual prominence of specific site types needs to be evaluated.

Visual Prominence of Site Types by Physiographic Zone

The results for the visual prominence of site types indicate that the Principal Group is the most visible location from all physiographic zones (Table 7.10). These results are expected and replicate the valley-wide findings; however, the results for the residential sites are unexpected. Table 7.10 compiles the visibility values for all site types by zone and shows that type 3 sites were the most visible residential site type. While the high visibility of type 3 sites may indicate a specialized function for these sites, for example, local temples or administrative centers, a closer examination of the data is required.

Table 7.10: ***Kruskal-Wallis test: visibility values by zone for all site types***

Site Types	Zone 2	Zone 3	Zone 4	Zone 5
1	0.380	0.297	0.490	0.079
2	0.526	0.289	0.636	0.031
3	**0.620**	**0.440**	**0.720**	**0.080**
4	0.567	0.333	0.667	0.063
5	0.979	0.498	0.860	0.083

The Kruskal-Wallis test suggests that differences exist in the visual prominence of site types located in different physiographic zones; however, the Mann-Whitney test indicates that statistically significant differences occur only between particular site types (see Appendix F for data tables). In fact, statistically significant differences between type 3 sites and all other sites type occur only in Zone 2. Moreover, the physiographic zone pattern is the only analytical scale that does not replicate the access results. These two concerns lead me to question the relevance of the physiographic zone pattern for understanding ancient sociopolitical organization at Copán.

Visual Connectedness Observations

In almost all cases, there is a lack of statistical significance in the visual connectedness of site types located in different physiographic zones, yet certain patterns do appear in the data.

1. All sites located in Zones 2, 3, and 4 are most visually connected to elite sites (type 3 or 4).

2. In Zone 5, type 1 and 2 sites are most visually connected to type 1 sites.
3. In Zone 5, type 3 and 4 sites are most visually connected to type 3 sites.

The results suggest that the elite living in Zones 2, 3, and 4 desired visual ties with people from a wide range of social backgrounds. In contrast, the elite living in Zone 5 intentionally established visual connections to other elite living in the valley rather than to commoners. These findings may reflect a higher degree of sociopolitical control in the central and eastern parts of the valley than in the western part. Interestingly, these patterns replicate the access results, suggesting that despite the lack of statistical significance, the data may be relevant to understanding social connectivity at Copán (and in fact the p-values are much closer to 0.05 than are the visual prominence p-values).

Visibility Results for Urban-Hinterland Interaction Spheres

Visual Prominence

The Kruskal-Wallis test indicates that sites located in the urban core were, on average, five times more visible than hinterland sites. These results indicate that people living in or near the city's center were more likely to be visually connected to other city residents, while individuals living in the hinterlands were more visually isolated from the majority of Copán's residents.

Table 7.11: *Kruskal-Wallis test: overall visibility for urban core and hinterlands*

	Visibility Value
Urban Core	0.544
Hinterlands	0.096
p-value = <0.0001	

Visual Prominence of Site Types in Urban Core and Hinterlands

Table 7.12 summarizes the visual prominence of Copán's site types for the urban core and the hinterlands. The p-values indicate that significant differences in visibility exist among site types in the urban core but not in the hinterlands. The Mann-Whitney results in Table 7.13 show that significant differences in visibility exist in the urban core between site types 1 and 2 but not site types 3 and 4. The results suggest that Copán's urban elite used the visibility of their households to differentiate themselves from commoners, but they did not employ this same strategy in the hinterlands. Perhaps these findings reflect less social inequality and/or social tension in the hinterlands, with less of a need to send visual messages of power and class distinction. These differences may arise from the fact that there appear to have been fewer elites in the hinterlands.

Table 7.12: ***Kruskal-Wallis test: visibility of site types for urban core and hinterlands***

Site Types	Urban Core (Visibility Value)	Hinterlands (Visibility Value)
1	0.380	**0.138**
2	0.518	0.095
3	0.580	0.080
4	**0.600**	0.067
5	0.886	0.470
	p-value = <0.0001	p-value = 0.751

Table 7.13: ***Mann-Whitney test: valley-wide visibility results for site types in urban core***

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		[1]**Y**	[2]**Y**	[3]**Y**	[3]**Y**
Type 2			[4]**Y**	[5]**Y**	[3]**Y**
Type 3				**N**	[3]**Y**
Type 4					[3]**Y**
Significance level: [1]< 0.0003 [2] 0.0001 [3]<0.0001 [4]<0.0223 [5]<0.0385					

Observations on visual prominence of site types in urban core vs. hinterlands:

1. The Principal Group (site type 5) was the most visually prominent site type in the valley.

2. Type 4 sites were the most visually prominent residential site type in the urban core.

3. Type 1 sites were the most visually prominent residential site type in the hinterlands.

4. Type 1 sites were the least visually prominent residential site type in the urban core.

5. Type 4 sites were the least visually prominent residential site type in the hinterlands.

6. The residents of the urban core sent messages of class distinction via the visibility of their residences, while residents of the hinterlands did so to a lesser degree.

The data indicate that in the urban core elite complexes (type 3 and 4 sites) were more visually prominent than commoner households; however, the reverse pattern existed in the hinterlands, that is, commoner households (type 1 and 2 sites) were more visually prominent than elite complexes. The results suggest that visual contact between the elite and other members of society was more valued or necessary within the city center than it was in the hinterlands. The visual prominence of elite compounds may have served to remind others, especially other elite living in the vicinity, of their wealth, power, and status. It may also have served as a way to visually connect the elite to each other. These data suggest that visibility may have facilitated communication flow among select social groups and served as a mechanism of social cohesion among the site's growing elite, especially in the later years of the Late Classic—a period of increasing environmental stress and sociopolitical competition (W. Fash 2001; Webster 2002).

Visual Connectedness among Site Types in Urban Core and Hinterlands

The differences in the visual connectedness of all site types located in the urban core were statistically significant (see Appendix F for data tables). The data indicate that type 1 and 2 sites were most visually connected to type 3 sites, whereas type 3 and 4 sites were most visually connected to type 4 sites. The differences in visual connectedness possibly indicate a greater degree of social interaction between commoners living at type 1 and 2 sites and the elite living at type 3 sites. This pattern may reflect specific social, political, or economic relations between commoners and the elite at type 3 sites. One possible explanation is that the type 3 elite served as middlemen between commoners and higher-status elite occupying type 4 sites, who in turn—according to the access data—had the highest degree of social connectivity with the king (Tables 6.57, 6.59, and 6.61).

In contrast, commoners living at type 1 and 2 sites in the hinterlands were most visually connected to other type 1 and 2 sites, not to elite sites. Like the access results, these findings suggest a lesser degree, via a less watchful eye of the elite, of social control in the hinterlands than in the urban core.

Assessing Visibility for Copán's Sub-Communities (*Sian Otots*)

Visual Prominence

The final and smallest analytical scale measures visibility among Copán's twenty residential s*ian otots* and the Principal Group to understand the visual prominence and visual connectedness of sub-communities in the valley. The Kruskal-Wallis tests suggest significant differences in the visual prominence of Copán's *sian otots* (p-value <0.0001).

Table 7.14 lists the visibility values of the *sian otots* sequentially, from most to least visible.

Table 7.14: ***Visibility ranking and visibility classes of sian otots (most visible to least visible)***

Sian Otot	Zone	Urban-Hinterland	Visibility Value	Rank	Visibility Class
San Lucas	4	Hinterland	0.828	1	A
Principal Group	2	Urban	0.759	2	A
San Rafael	4	Hinterland	0.768	3	A
Salamar	3	Urban	0.552	4	B
Las Sepulturas	2	Urban	0.534	5	B
El Puente	4	Hinterland	0.533	6	B
Titichon	4	Hinterland	0.521	7	B
Comedero	3	Urban	0.485	8	B
Chorro	3	Urban	0.484	9	B
El Bosque	2	Urban	0.473	10	B
Rastrojon	3	Hinterland	0.465	11	B
Algodonal	5	Hinterland	0.405	12	B
Mesa de Petapilla	3	Hinterland	0.259	13	C
Titoror	3	Hinterland	0.183	14	C
El Pueblo	3	Hinterland	0.093	15	D
Estanzuela	5	Hinterland	0.072	16	D
Ostuman	5	Hinterland	0.067	17	D
Rincon del Buey	5	Hinterland	0.040	18	D
Tapescos	5	Hinterland	0.034	19	D
Bolsa de Petapilla	3	Hinterland	0.014	20	D
Yaragua	5	Hinterland	0.004	21	D

Using the *Natural Breaks (Jenks Optimization) Classification* tool in ArcGIS 9.1, I assigned the visibility values to four classes: Class A, very high (visibility value >0.552000); Class B, high (visibility value 0.552000−0.259001); Class C, moderate (visibility value 0.259000−0.093001); and Class D, low (visibility value 0.093000−0.004000). The graph in Figure 7.7 illustrates the natural breaks in the data. These classes served as comparative tools for evaluating differences and similarities in visibility among Copán’s sub-communities.

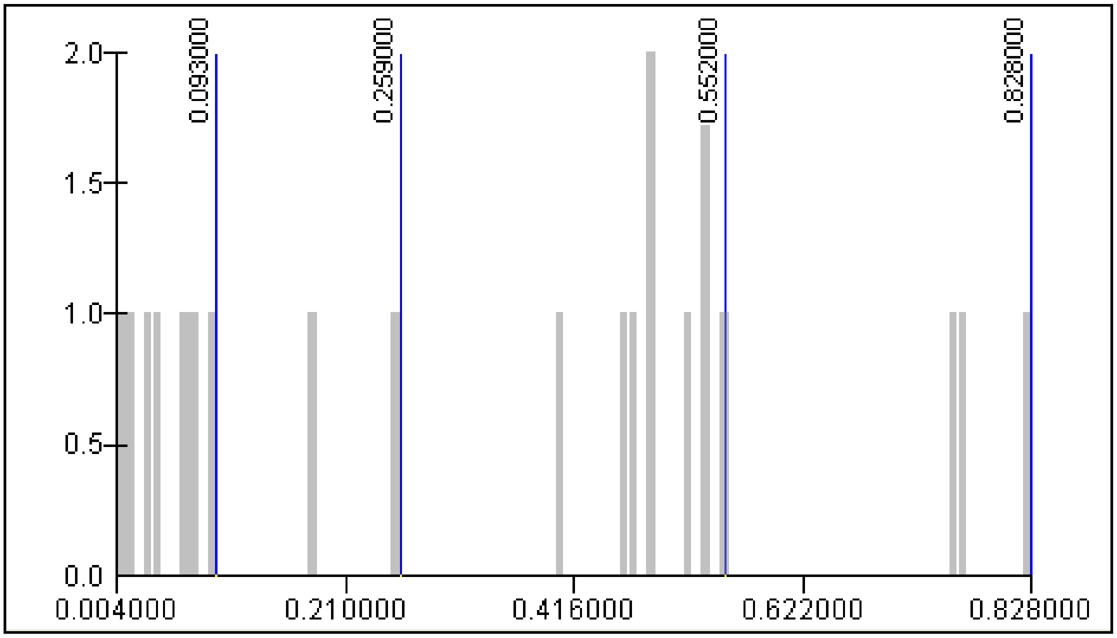


Figure 7.7:* Natural breaks (Jenks Optimization) classification of visibility values for *sian otots

Figure 7.8 maps Copán's *sian otot*s according to visibility class and shows that neighboring, or adjacent, *sian otots* often have a similar range of visibility values. Class A *sian otots* include the Principal Group and sites located in two sub-communities in the southeast part of the valley, San Lucas and San Rafael, in the most visible parts of the valley. Class A sub-communities are surrounded by Class B sub-communities, which were predominantly located in the central and eastern parts of the valley. There were only two Class C *sian otots*, both in the northeast part of the valley, and Class D sub-communities were located in the western part of the valley (with the exception of Bolsa de Petapilla). A pattern emerges from these data that refines the urban core−hinterland results. The data indicate that western sub-communities were less visible than central and eastern sub-communities, highlighting a west-east spatial division in the valley.

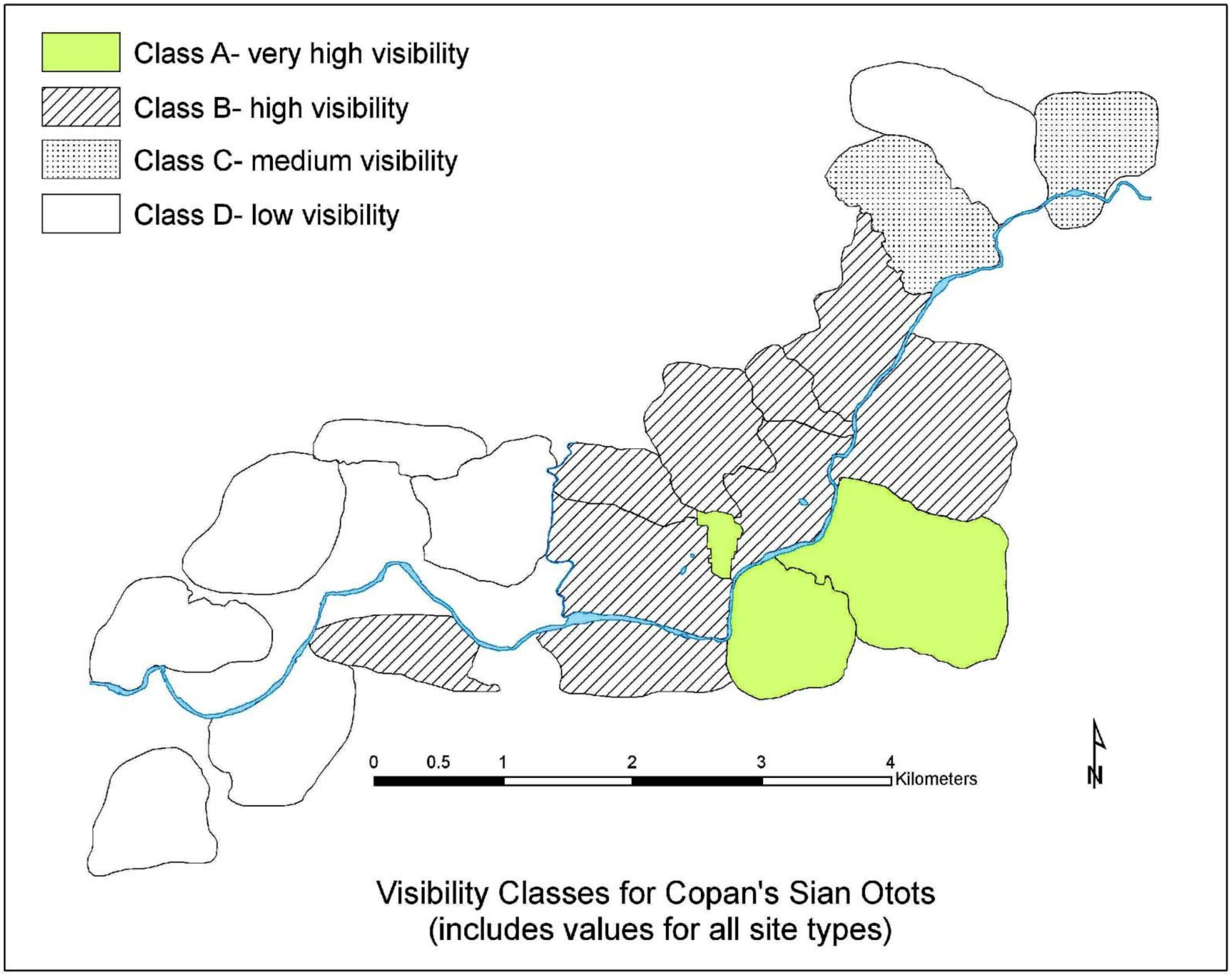


Figure 7.8:* Distribution of visibility classes for Copán's *sian otots

What factors, ecological or social, might be responsible for this pattern? Again, elevation, topography, and settlement density come into play. Figure 7.9 illustrates that absolute elevation is not always responsible for the visual prominence of *sian otots*. The contour maps show two sub-communities that have similar elevation values, yet have very different visibility values: San Lucas has a visibility value of 0.828, and Bolsa de Petapilla has a value of only 0.014.

Although elevation does not appear to be directly responsible for the visual prominence of *sian otots*, it is possible that topography (surface contours) and/or settlement density may influence visibility at this smaller scale of analysis. In general, topography is often a primary determinant of visibility; objects on hilltops or ridgelines are typically more visible than those in flat valley floors, as they can be seen against the sky (Llobera 1996, 2000; Ogburn 2006). This phenomenon most likely explains the high visibility of many sites located on the steep hillsides of San Rafael and San Lucas.

As for settlement density, the common assumption is that the more structures in close proximity, the more there are to see and consequently the higher the visibility ranking. Table 7.15 compares the visibility class and settlement density of Copán's *sian otots*. A visual inspection of the table suggests that visibility and settlement density are not directly correlated. In order to test this assumption empirically, I employed the Pearson Coefficient of Correlation test to measure the degree of the linear relationship between the variables of settlement density and visibility.

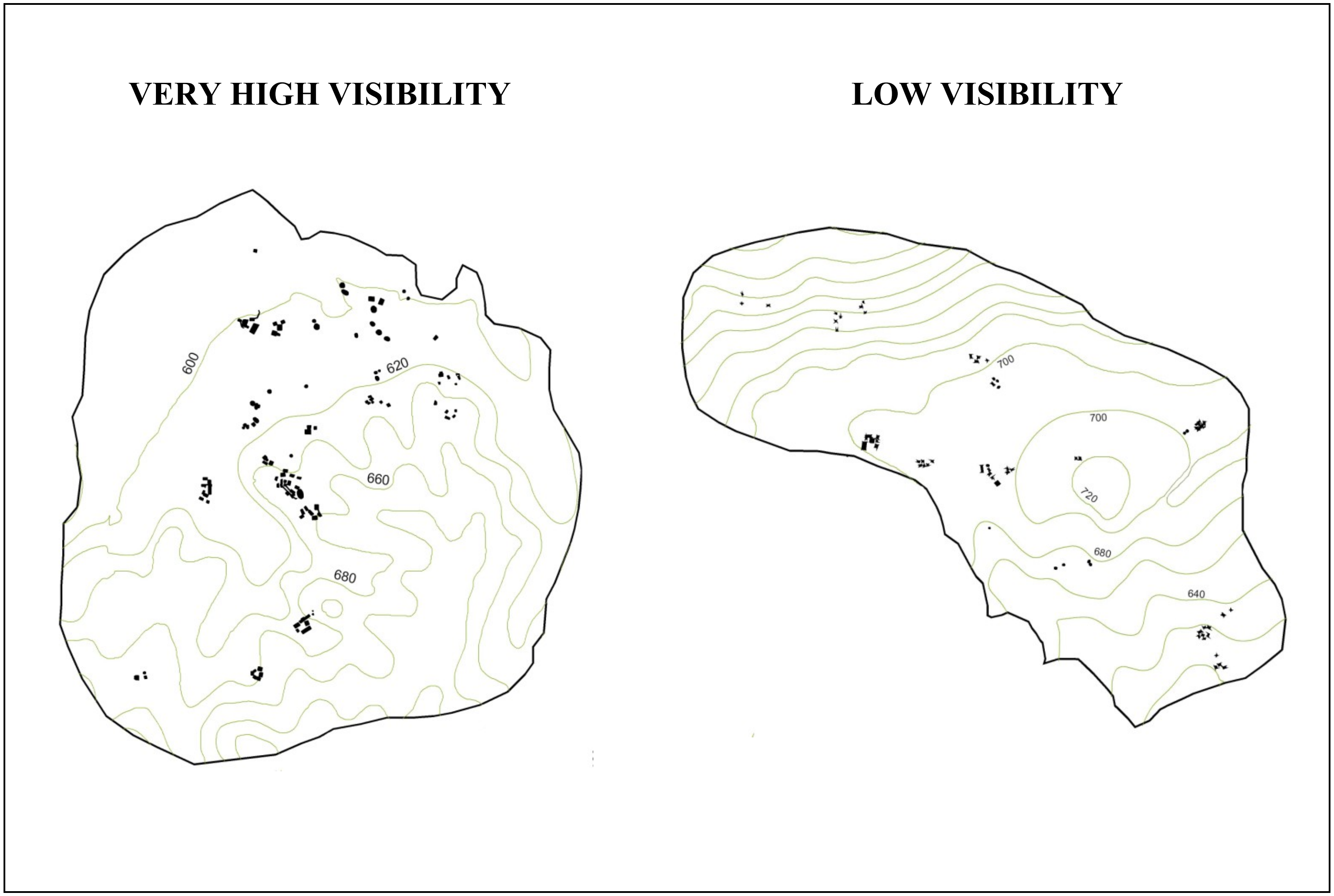


Figure 7.9: **Contour maps of San Lucas (left) and Bolsa de Petapilla (right)**

Table 7.15: *Settlement density of Copán Valley* sian otots *in relation to visibility*

Sian Otot	**Visibility Class**	**Settlement Density (km^2)**
Las Sepulturas	B	686.36
Salamar	B	385.90
El Bosque	B	345.79
Chorro	B	334.48
Rastrojon	B	320.73
Comedero	B	274.42
San Lucas	A	226.19
Mesa de Petapilla	C	179.79
Ostuman	D	151.52
San Rafael	A	150.94
Estanzuela	D	121.59
Tapescos	D	116.44
Yaragua	D	100.00
Algodonal	B	96.36
Bolsa de Petapilla	D	89.42
Titichon	B	84.89
Rincon del Buey	D	82.28
Titoror	C	63.16
El Pueblo	D	52.75
El Puente	B	51.47
Principal Group	A	N/A

The results of the test provided a correlation coefficient of 0.458 with a p-value of 0.042, which indicates a mild positive correlation between the two variables. The scatterplot in Figure 7.10 illustrates that, to some degree, visibility increases as settlement density increases. However, it also shows that this correlation is not very strong. San Lucas and San Rafael, for example, have settlement densities between 150 and 227 persons/km^2 (see discussion later in this chapter), yet belong to Class A, that is, they have the highest visibility values. In contrast, Las Sepulturas, which has the highest settlement density (686.36 persons/km^2), belongs to Class B, with lower visibility values.

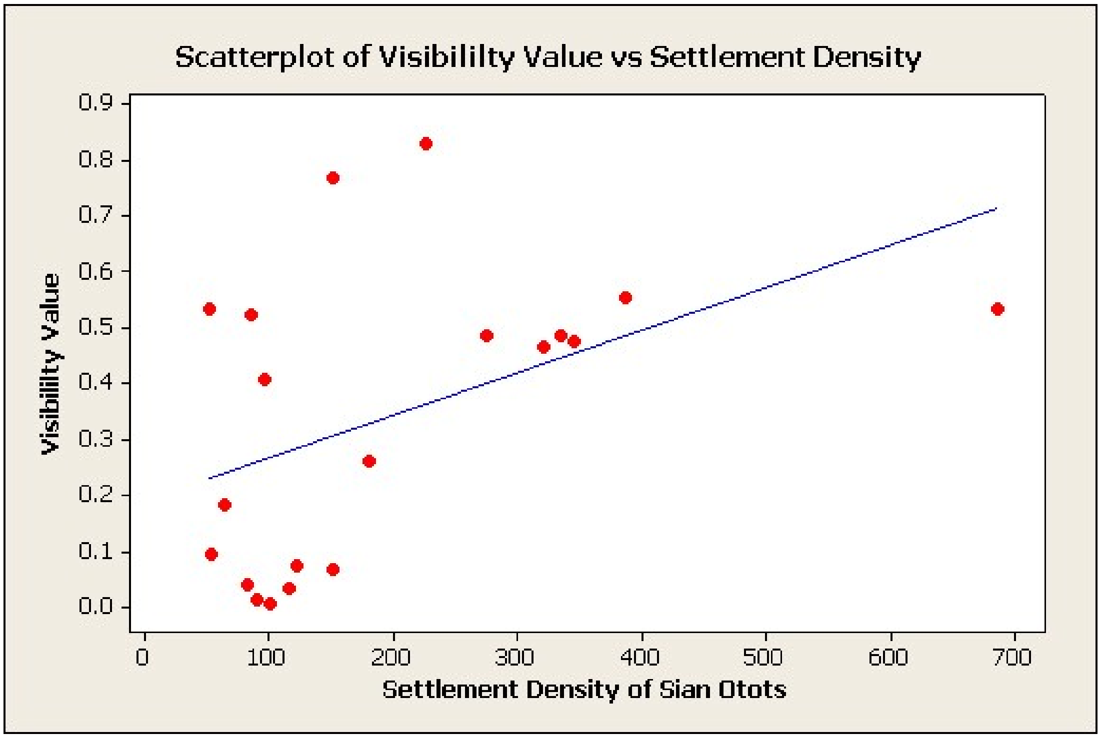


Figure 7.10: **Scatterplot of visibility values vs. settlement density for Copán's *sian otots***

Taken together the data suggest that multiple factors, both ecological and social, affected the overall visibility of *sian otots*. The next step in the study involved examining the differences and similarities in the visibility of site types for Copán's *sian otots.*

Visual Connectedness among Site Types—Sian Otots

Using the Kruskal-Wallis test, I examined whether the inhabitants of specific sub-communities were more visually connected to type 1, 2, 3, 4, or 5 sites. I analyzed these data in two ways. First, I used the data tables in Appendix I to map each *sian otot* according to site type with the highest visibility value. Figure 7.11 shows that there may have been a tripartite division in the valley.

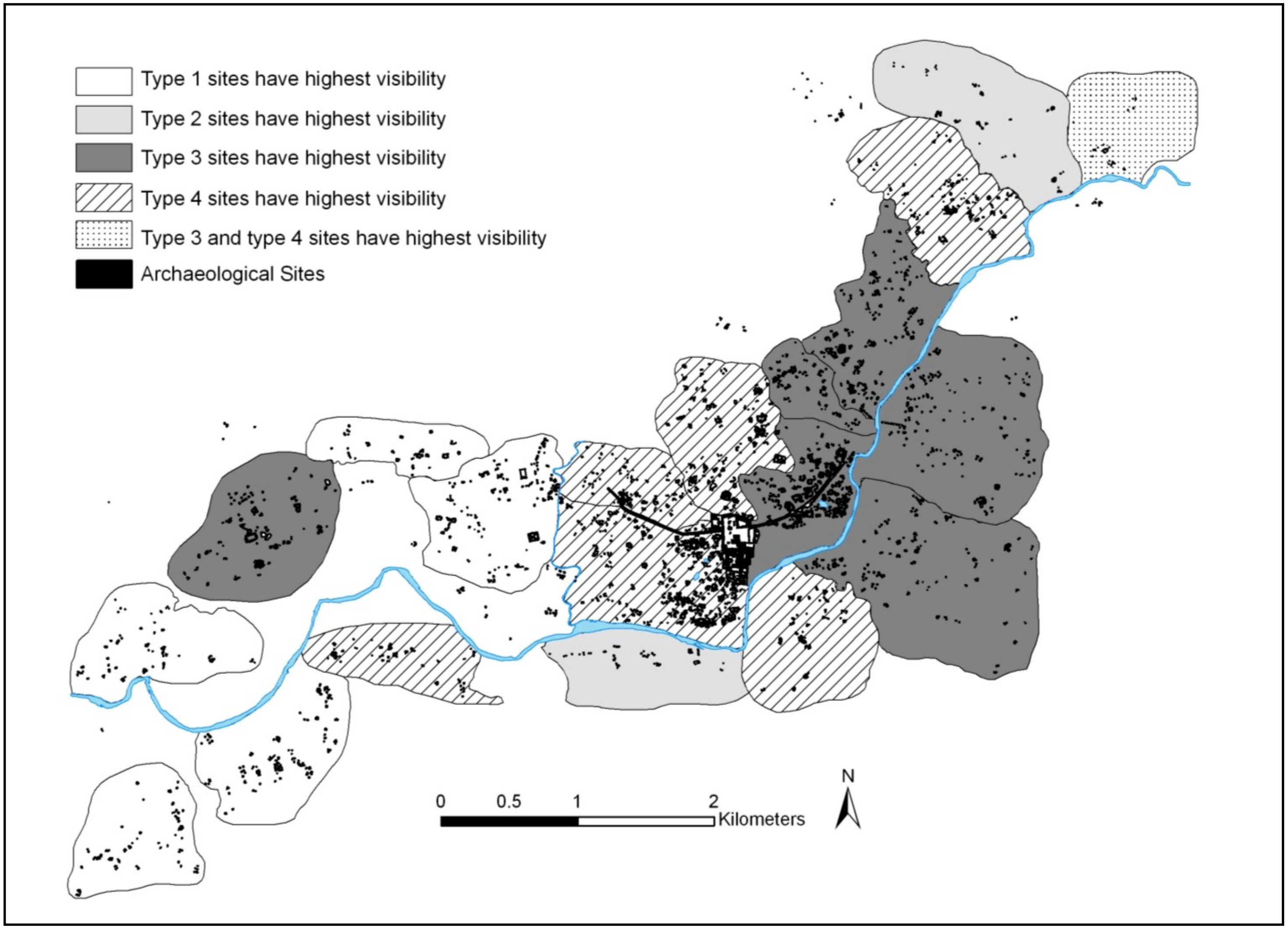


Figure 7.11: **Map illustrating site types with highest visibility by *sian otot***

Generally speaking, sites with greatest visibility in the west were type 1, type 4 in the central region, and type 3 in the east. A comparison of Figure 7.11 to Figure 6.5 indicates similarities in the integration and visibility of site types at Copán. In both cases, type 4 sites were more prominent and accessible in the central part of the valley and type 3 sites were in the eastern part. Moreover, the fact that several western sub-communities are most visually connected to type 1 sites suggests less sociopolitical control in this area than in the central and eastern parts of the valley, where type 3 and 4 sites have the strongest visual ties. This spatial pattern also replicates the access study results, indicates less sociopolitical control in terms of channeling people to particular sites in the western part of the valley than in the eastern part.

Second, I summarized the visibility values obtained from the Kruskal-Wallis tests into Tables 7.16−7.19. These tables compare the visual prominence of each site type from a given sub-community to that sub-community's overall visual prominence. For example, if a site type's visibility value is higher than the average/norm for a particular sub-community, than that site type is more visually prominent than expected and is driving the visibility of the sub-community higher. These data were grouped using the same visibility classes (A−D) used for overall visibility, then mapped to facilitate comparisons.

Type 1 Sites

Table 7.16 shows that fifteen of Copán's *sian otots* exhibit lower than expected visibility values for type 1 sites, while only six *sian otots* have values that are higher than expected. The following pattern emerges: sub-communities with the lowest overall visibility actually have higher than expected visibility values for type 1 sites.

Table 7.16: ***Visibility values and ranking of type 1 sites for Copán's*** **sian otots**

Sian Otot	**Visibility Value**	**Overall Visibility**	**Lower/Higher than Expected**	**Visibility Class**
San Lucas	0.662	0.808	Lower	A
San Rafael	0.649	0.768	Lower	A
Principal Group	0.554	0.759	Lower	A
Chorro	0.435	0.484	Lower	B
Las Sepulturas	0.415	0.534	Lower	B
El Puente	0.396	0.533	Lower	B
Rastrojon	0.393	0.465	Lower	B
Comedero	0.389	0.485	Lower	B
Salamar	0.389	0.552	Lower	B
El Bosque	0.375	0.473	Lower	B
Titichon	0.372	0.521	Lower	B
Algodonal	0.361	0.405	Lower	B
Mesa de Petapilla	0.181	0.259	Lower	C
El Pueblo	0.147	0.093	Higher	C
Titoror	0.138	0.183	Lower	C
Rincon del Buey	0.107	0.040	Higher	C
Tapescos	0.102	0.034	Higher	C
Estanzuela	0.086	0.072	Higher	D
Yaragua	0.066	0.004	Higher	D
Ostuman	0.061	0.067	Lower	D
Bolsa de Petapilla	0.059	0.014	Higher	D
p-value = 0.057				

Figure 7.12 shows that type 1 sites were most visually prominent for the sub-communities of San Lucas and San Rafael, both located on the southern side of the Río Copán. However, these results are not unexpected, as these two communities have Class A visual prominence (Table 7.16). Of greater interest is that sub-communities with a high degree of visual connectedness to type 1 sites are all located in the western half of the valley, with the exception of Bolsa de Petapilla, which is in the far northeast corner. Figure 7.12 illustrates this pattern and provides additional support for an east-west spatial division in the valley.

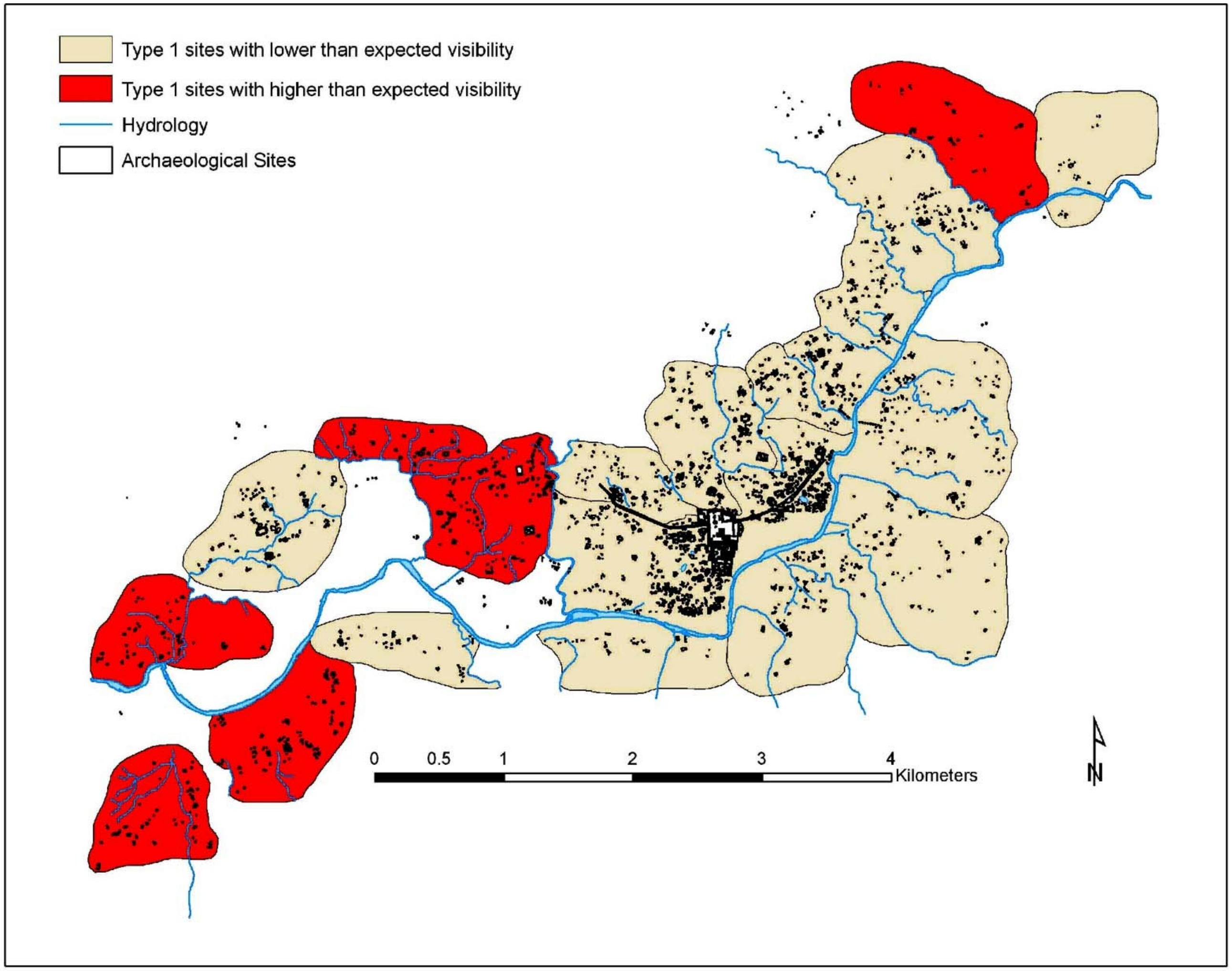


Figure 7.12: **Map illustrating visual connectedness of type 1 sites by *sian otot* in Copán Valley**

Type 2 Sites

Table 7.17 and Figure 7.13 show that seven western sub-communities had higher than expected visual ties to type 2 sites. Taken together, the results for type 1 and type 2 sites indicate that most western sub-communities had stronger than expected visual ties with commoners than with elites. How this pattern informs on Copán's sociopolitical organization, is discussed following examination of sub-community data for type 3 and 4 sites.

Table 7.17: *Visibility values and ranking of type 2 sites for Copán's* sian otots

Sian Otot	**Visibility Value**	**Overall Visibility**	**Lower/Higher than Expected**	**Visibility Class**
San Lucas	0.781	0.808	Lower	A
Principal Group	0.750	0.759	Lower	A
San Rafael	0.737	0.768	Lower	A
El Puente	0.579	0.533	Higher	A
Salamar	0.540	0.552	Lower	B
Las Sepulturas	0.526	0.534	Lower	B
El Bosque	0.513	0.473	Higher	B
Comedero	0.470	0.485	Lower	B
Titichon	0.465	0.521	Lower	B
Algodonal	0.417	0.405	Higher	B
Rastrojon	0.408	0.465	Lower	B
Chorro	0.386	0.484	Lower	B
Mesa de Petapilla	0.237	0.259	Lower	C
Titoror	0.167	0.183	Lower	C
El Pueblo	0.095	0.093	Higher	C
Bolsa de Petapilla	0.061	0.014	Higher	D
Tapescos	0.053	0.034	Higher	D
Estanzuela	0.053	0.072	Lower	D
Rincon del Buey	0.044	0.040	Higher	D
Ostuman	0.018	0.067	Lower	D
Yaragua	0.013	0.004	Lower	D
p-value = 0.016				

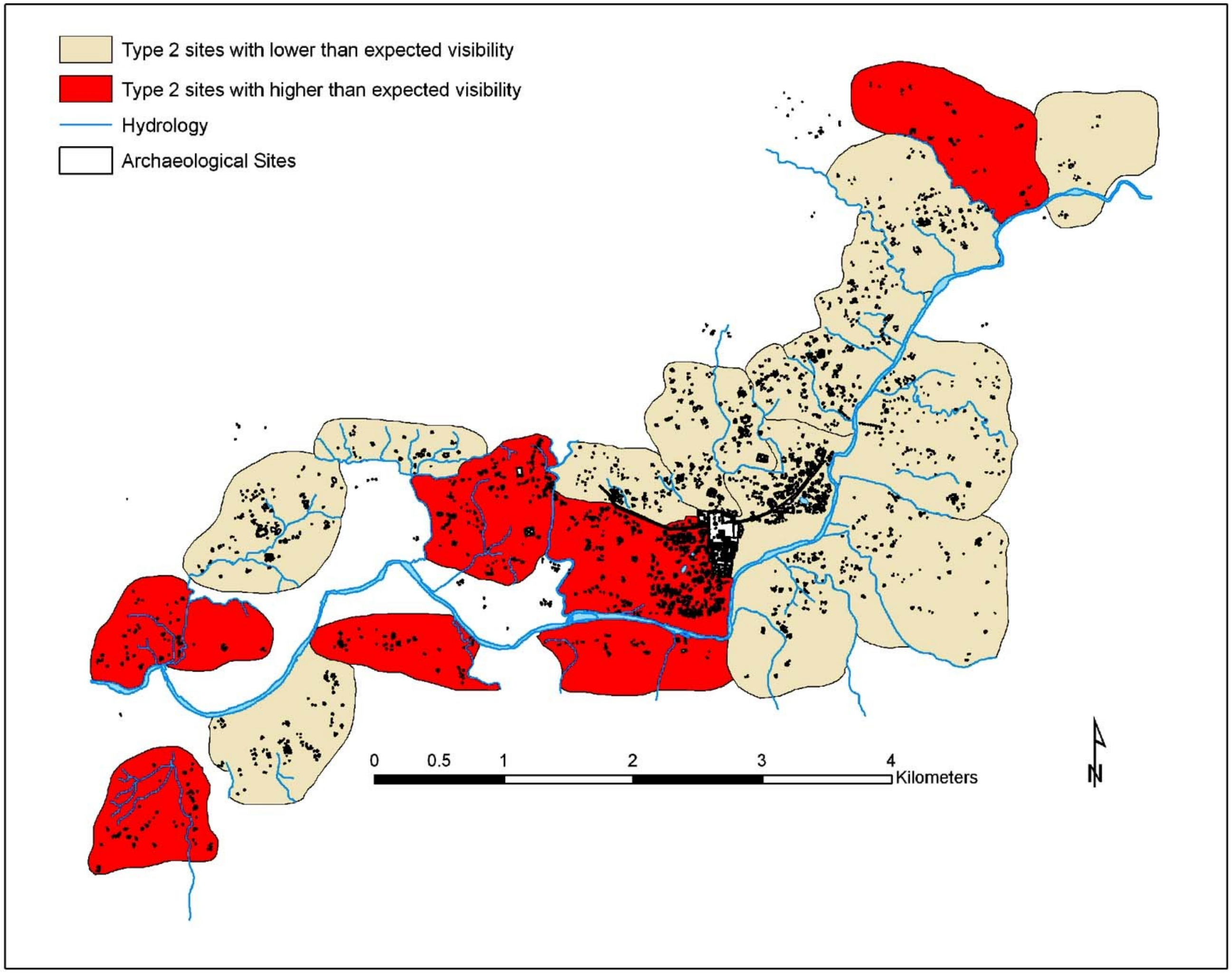


Figure 7.13: **Map illustrating visual connectedness of type 2 sites by *sian otot* in Copán Valley**

Type 3 Sites

The visibility findings for type 3 sites are markedly different from the type 1 and type 2 site results. Table 7.18 highlights in bold the sixteen sub-communities that have expected or higher than expected visibility for type 3 sites; only five have lower than expected values. In contrast, only six sub-communities had higher than expected visibility for type 1 sites, and only seven for type 2 sites. These results suggest that for many sub-communities either the maintenance of a visual connection with type 3 sites was very important or the occupants of type 3 sites intentionally targeted a wide audience across the valley.

Table 7.18: *Visibility values and ranking of type 3 sites for Copán's* sian otots

Sian Otot	**Visibility Value**	**Overall Visibility**	**Lower/Higher than Expected**	**Visibility Class**
Principal Group	0.875	0.759	Higher	A
San Lucas	0.820	0.808	Higher	A
San Rafael	0.880	0.768	Higher	A
Las Sepulturas	0.700	0.534	Higher	A
Titichon	0.640	0.521	Higher	A
Chorro	0.600	0.484	Higher	A
Rastrojon	0.560	0.465	Higher	A
Salamar	0.560	0.552	Higher	A
El Puente	0.540	0.533	Higher	B
El Bosque	0.520	0.473	Higher	B
Comedero	0.420	0.485	Lower	B
Mesa de Petapilla	0.400	0.259	Higher	B
Algodonal	0.360	0.405	Lower	B
Titoror	0.200	0.183	Higher	C
Estanzuela	0.080	0.072	Higher	D
El Pueblo	0.080	0.093	Lower	D
Ostuman	0.080	0.067	Higher	D
Rincon del Buey	0.040	0.040	Expected	D
Tapescos	0.040	0.034	Higher	D
Bolsa de Petapilla	0.000	0.014	Lower	D
Yaragua	0.000	0.004	Lower	D
p-value = 0.003				

Figure 7.14 illustrates that Copán's sub-communities maintained a very high degree of visual connectedness with type 3 sites; the primary exceptions were those sub-

communities just to the west of the urban core. Although many of the far western sub-communities have higher than expected visibility values for type 3 sites, the values in Table 7.18 show that the visibility values in the eastern part of the valley are much higher than expected, whereas the visibility values for western sub-communities are closer to what was expected. For example, the visibility value for type 3 sites in Las Sepulturas is 0.700, whereas the overall visibility value for all site types in Las Sepulturas is only 0.534—a marked difference. In contrast, the visibility value for type 3 sites in Estanzuela is 0.080 and its overall visibility value is only slightly lower, at 0.072.

Many commoners and elites throughout the valley, especially in the central and eastern parts, had strong visual ties to type 3 sites. Type 3 sites, therefore, provided better opportunities to send targeted visual messages than did type 1 and 2 sites. Such a high degree of visual connectedness may have served to bring people together, play some sort of centralizing role, and facilitate social interaction. These strong visual ties may have also helped the elite living at type 3 sites to demonstrate their wealth and power, letting Copán's inhabitants know that they were watching over them and referencing the Maya belief that to be all-seeing is to be all-knowing (Houston et al. 2006).

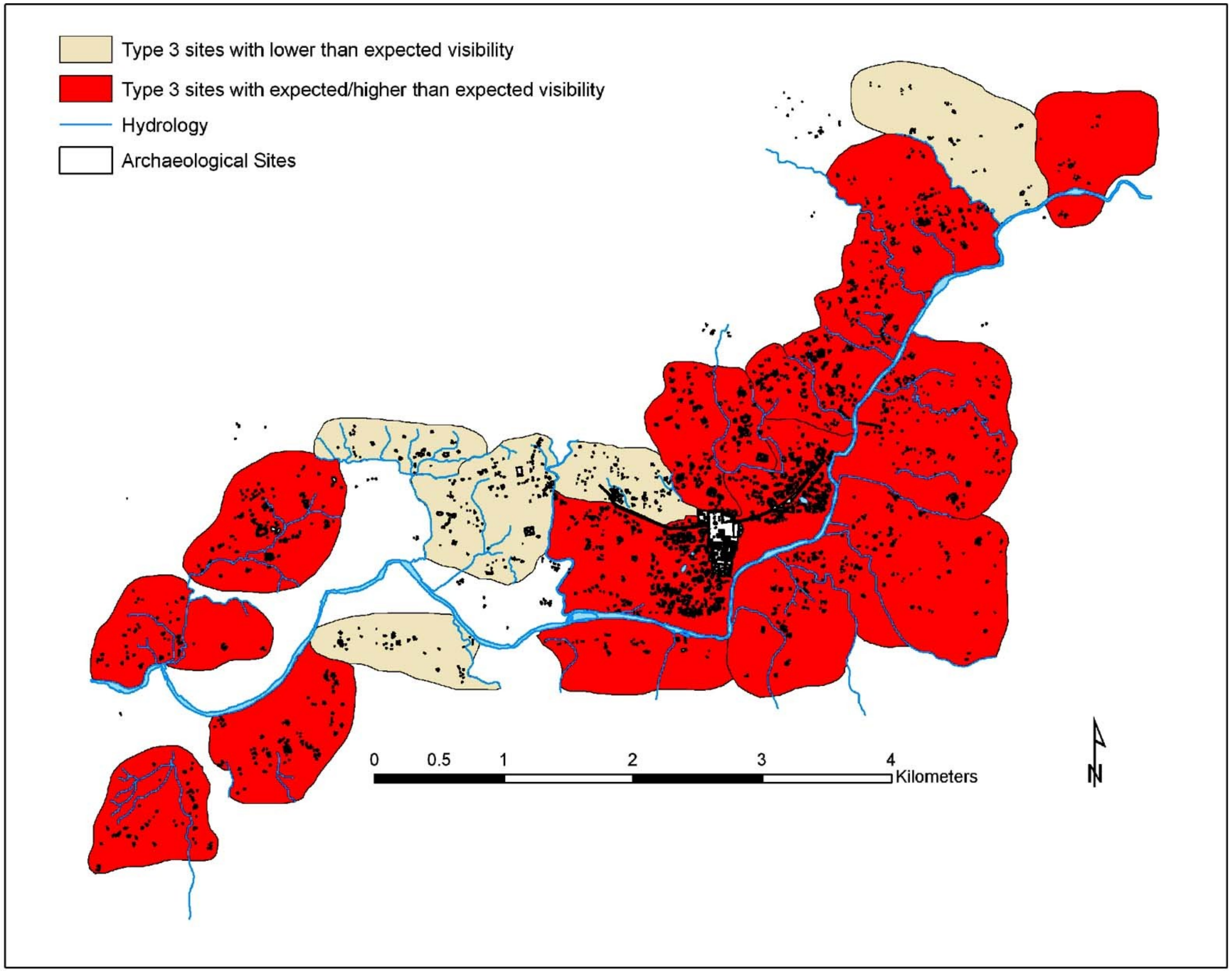


Figure 7.14: **Map illustrating visual connectedness of type 3 Sites by *sian otot* in Copán Valley**

Type 4 Sites

The visibility patterns for type 4 sites are very similar to those for type 3 sites. Table 7.19 shows that type 4 sites had higher than expected visibility in fourteen sub-communities, only two less than for type 3 sites. Figure 7.15 shows that type 4 sites had a very high degree of visual connectedness with sub-communities located in the central and eastern parts of the valley but very little visual connectedness to most western sub-communities. While this pattern is similar to the type 3 pattern, type 3 sites have slightly stronger visual ties in the western part of the valley.

Table 7.19: *Visibility values and ranking of type 4 sites for Copán's* sian otots

Sian Otot	Visibility Value	Overall Visibility	Lower/Higher than Expected	Visibility Class
Principal Group	0.875	0.759	Higher	A
San Lucas	0.867	0.808	Higher	A
San Rafael	0.800	0.768	Higher	A
Salamar	0.734	0.552	Higher	A
Chorro	0.733	0.484	Higher	A
Comedero	0.617	0.485	Higher	A
Las Sepulturas	0.567	0.534	Higher	A
Rastrojon	0.567	0.465	Higher	A
El Bosque	0.567	0.473	Higher	A
El Puente	0.533	0.533	Expected	B
Algodonal	0.500	0.405	Higher	B
Titichon	0.467	0.521	Lower	B
Mesa de Petapilla	0.333	0.259	Higher	B
Titoror	0.200	0.183	Higher	C
Ostuman	0.067	0.067	Expected	D
El Pueblo	0.063	0.093	Lower	D
Estanzuela	0.000	0.072	Lower	D
Rincon del Buey	0.000	0.040	Lower	D
Tapescos	0.000	0.034	Lower	D
Bolsa de Petapilla	0.000	0.014	Lower	D
Yaragua	0.000	0.004	Lower	D
p-value = 0.001				

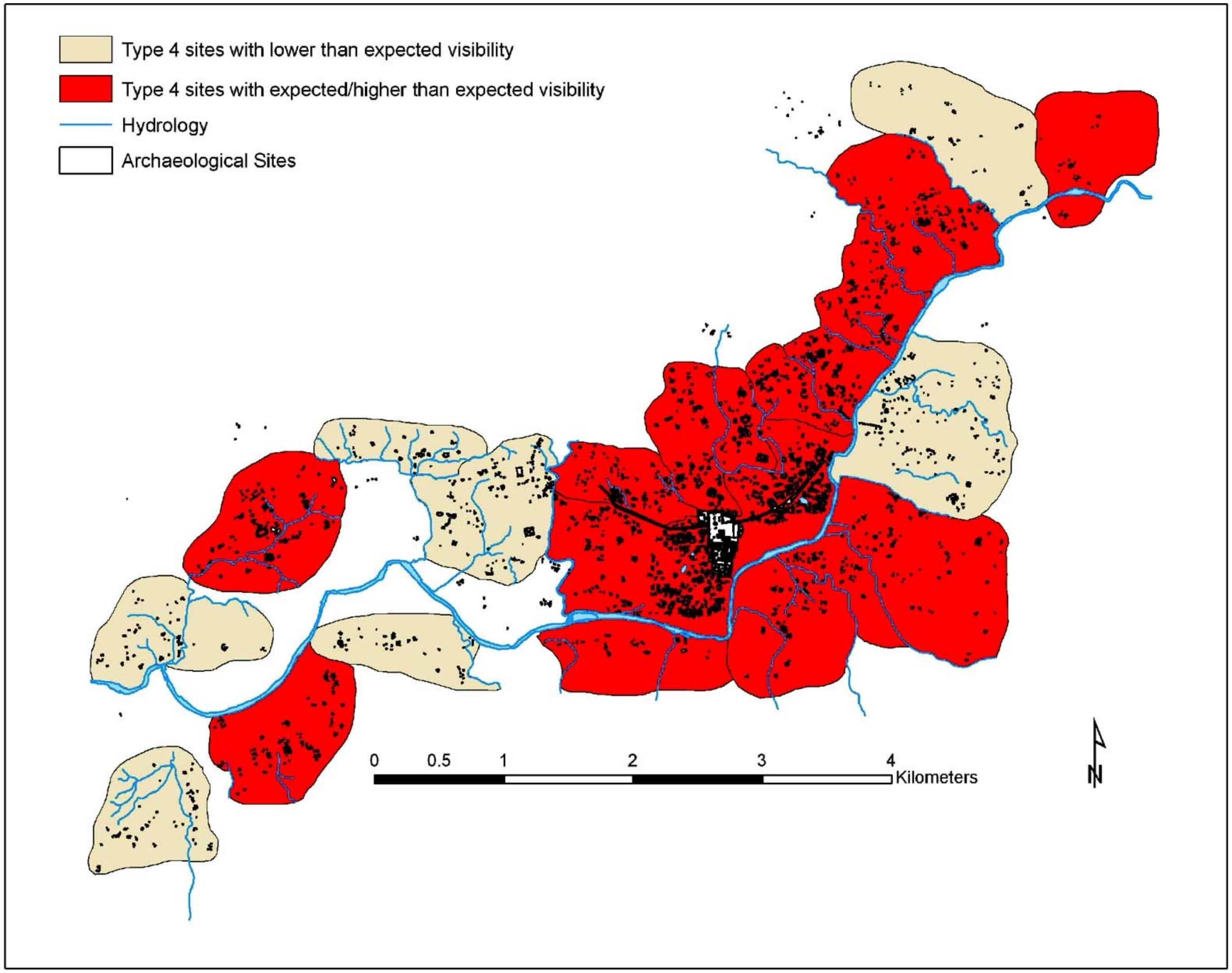


Figure 7.15: **Map illustrating visual connectedness of type 4 sites by *sian otot* in Copán Valley**

Moreover, five out of seven sub-communities with lower than expected visibility of type 4 sites had visibility values zero. This means that no type 4 sites could be seen from households within these sub-communities. In contrast, only two sub-communities maintained absolutely no visual contact with type 3 sites, supporting the conclusion that people living at type 3 sites had wider visual contacts with Copanecos than people living at type 4 sites. Interestingly, these data provide some support for the extremely high visual prominence of type 3 sites identified in the physiographic zone results (which at first seemed anomalous). Taken together with the fact that type 3 sites in the urban core had stronger visual ties to type 1 and 2 sites than type 4 sites, perhaps the data highlight specialized function(s) for type 3 sites, such as community shrines, administrative centers, or middlemen between higher status elites living at type 4 sites.

Type 5 Sites

Table 7.20 and Figure 7.16 indicate that type 5 sites exhibit a similar visibility pattern to type 4 sites. That is, the Principal Group maintained strong visual ties with sub-communities located in the central and eastern parts of the valley, but almost no visual ties to people living in western sub-communities. Moreover, the visibility values in sub-communities with higher than expected visibility for type 5 sites are very high; in contrast, those that have lower than expected visibility have very low values, zero in five cases. The results show that although a large percentage of commoners (59.5%) and elites (87.5%) were able to see the monuments of the Principal Group, the majority of these people lived in the central and eastern parts of the valley.

Table 7.20: ***Visibility values and ranking of the Principal Group (type 5) for Copán's*** **sian otots**

Sian Otot	Visibility Value	Overall Visibility	Lower/Higher than Expected	Visibility Class
San Lucas	1.000	0.808	Higher	A
El Puente	1.000	0.533	Higher	A
Las Sepulturas	0.981	0.534	Higher	A
El Bosque	0.977	0.473	Higher	A
Comedero	0.905	0.485	Higher	A
San Rafael	0.841	0.768	Higher	A
Titichon	0.765	0.521	Higher	A
Salamar	0.727	0.552	Higher	A
Chorro	0.667	0.484	Higher	A
Titoror	0.571	0.183	Higher	B
Rastrojon	0.481	0.465	Higher	B
El Pueblo	0.385	0.093	Higher	B
Algodonal	0.375	0.405	Lower	B
Mesa de Petapilla	0.286	0.259	Higher	B
Rincon del Buey	0.214	0.040	Higher	C
Ostuman	0.000	0.067	Lower	D
Estanzuela	0.000	0.072	Lower	D
Tapescos	0.000	0.034	Lower	D
Bolsa de Petapilla	0.000	0.014	Lower	D
Yaragua	0.000	0.004	Lower	D

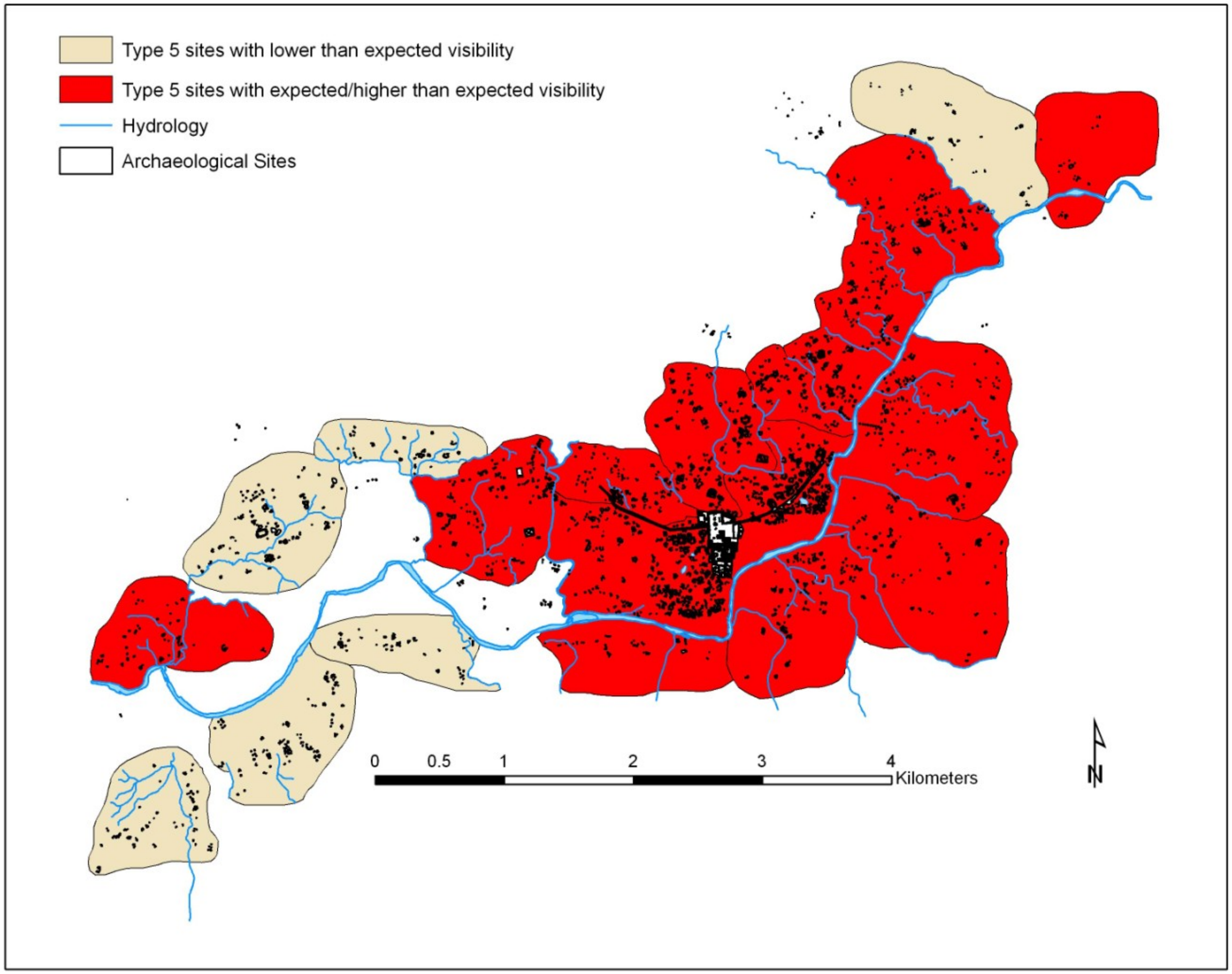


Figure 7.16: **Map illustrating visual connectedness of type 5 sites by *sian otot* in Copán Valley**

Summary of Observations for Copán's Sub-communities

1. Western sub-communities have strong visual ties to type 1 sites.
2. Central and far western sub-communities have strong visual ties to type 2 sites.
3. Type 3 sites maintain strong visual ties to the greatest number of sub-communities.
4. Central and eastern sub-communities have strong visual ties to type 4 sites.
5. Central and eastern sub-communities have strong visual ties to the Principal Group (type 5).

The sub-community data highlight three spatial patterns that provide information on ancient sociopolitical organization in the valley. The first pattern refines the valley-wide and urban core−hinterland results, pointing to an east-west division in the valley. The second pattern identifies the unexpectedly high visual prominence of type 3 sites, suggesting that they had a specialized function in society.

Pattern 1: Figure 7.17 combines these sub-community visibility data to illustrate that type 1 and 2 sites (commoner households) have higher than expected visibility in the western part of the valley, while type 3 and 4 sites (elite compounds) have higher than expected visibility in the east. In the east, there was greater visual focus on elite compounds, both type 3 and 4, which may be indicative of greater power centralization and a need for more social control in this part of the valley. Weak visual ties to elite complexes indicates that people living in western sub-communities were not the target of elite visual messages of power or supervision, and suggests that people living in the western part of the valley experienced less sociopolitical control. Given the eastern valley's longer occupation history (W. Fash 1983a), this pattern may reflect temporal differences. The fact that many people did not begin to occupy western sites—sites that lie beyond the watchful gaze of the most elites—until the end of the Late Classic may signify a weakening central authority (see W. Fash 2001) that could no longer control where people settled, or perhaps it was simply a consequence of overpopulation and the need to colonize new lands. There are two exceptions to the east-west pattern. The first exception is the western sub-community of Ostuman, which maintains strong visual ties to type 3 and 4 sites; however, two factors probably account for these results. First, it is an isolated intermontane pocket with very few external visibility ties (see Chapter 9) and second, it houses three elite compounds (one type 4 site and two type 3 sites), more than any other western sub-community, creating strong visual ties to elites but only those within the sub-community. The second exception is the eastern sub-community of Bolsa de Petapilla, which maintains strong visual ties to type 2 sites. Like Ostuman, these results can be explained by the fact that the sub-community has few external visibility ties (see Chapter 9) and that it houses two type 2 sites and no elite complexes. Thus, despite these two exceptions, the data provide strong evidence for an east-west spatial division in the valley.

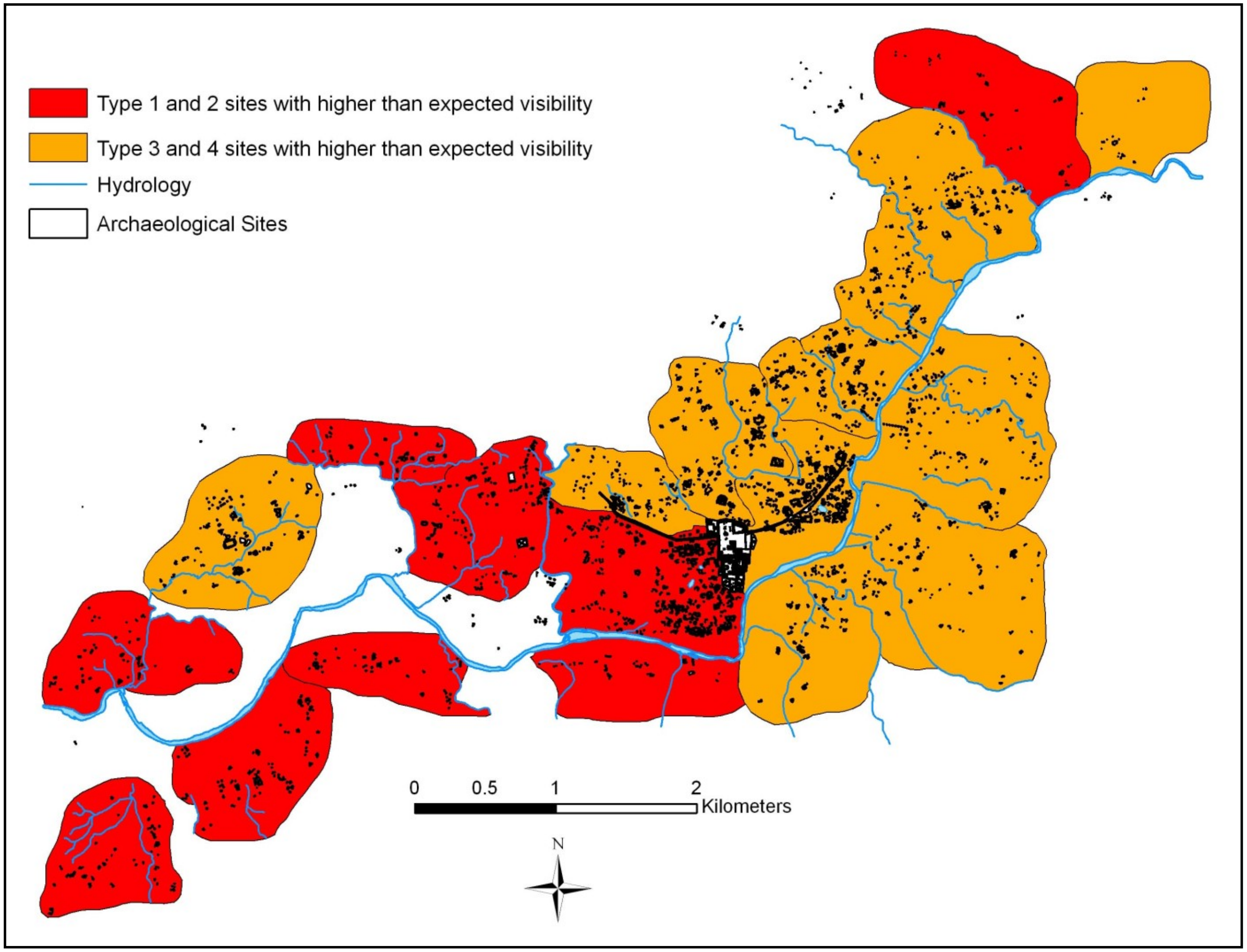


Figure 7.17: **Map illustrating locations of higher than expected visibility of Copán's residential site types**

Pattern 2: Figure 7.14 shows that type 3 sites maintained strong visual ties to sixteen of Copán's sub-communities. Surprisingly, type 4 sites and the Principal Group not only had strong visual ties to fewer sub-communities but they also had no visual contact at all with the residents of five sub-communities. In contrast, type 3 sites maintained at least some visual contact with all but two sub-communities. Moreover, type 3 sites in the urban core had stronger visual ties to type 1 and 2 sites than did type 4 sites. The fact that people living at type 3 sites maintained very strong visual ties to the majority of Copán's residents suggests, again, that they may have played a specialized role in society, among others as middlemen between higher status elite living at type 4 sites, who in turn (given their greater access to the Acropolis and Royal Courtyard—see Chapter 6) probably served as liaisons to the royal court.

Summary and Conclusions

Multi-scalar approaches allow archaeologists to identify multiple levels of sociopolitical interaction, refine patterns by revealing variation frequently masked at large scales, and bring to light methodological or typological issues. Along these lines, I measured visibility at four analytical scales—valley-wide, physiographic zone, urban core-hinterlands, and sub-communities. Analyzing the data from the largest to the smallest scale was a way to correlate visual ties to social connectivity among people living at distinct site types and between people living in particular areas of the valley. Ultimately, the results provide information that will help scholars to better understand the multi-scalar nature of sociopolitical organization in the late eighth and early ninth centuries at Copán.

Visual Prominence and Visual Connectedness of the Principal Group (Type 5)

According to both archaeological and ethnographic sources, the ancient Maya believed that those who were all-seeing were also all-knowing (Houston et al. 2006; Tedlock 1996). The fact that 76% of late eighth and early ninth century households in the Copán Valley could see the city's major civic-ceremonial center, the Principal Group, supports this belief. The high visibility of these structures is not unexpected—the tallest of them is believed to have towered nearly 35 meters above the valley floor (Hohmann and Vogrin 1982). In contrast, the tallest known residential structures (Str. 9N-82 and Str. 8N-66C) are only about 10 meters high (W. Fash 1989).

I return to one of the questions posed in the introduction to this chapter—*Was the king via Principal Group structures and the Royal Courtyard, more visually connected to elites or commoners?* While many Copanecos could see the city's massive civic-ceremonial buildings from their homes, a disproportionate number were elites. 87.5% of the elite could see the Principal Group, while only 59.5% of commoners could see it. On the one hand, these results may suggest that Ruler 16 and his administration intentionally targeted the elite, sending visual messages of power and legitimacy via architecture as part of a strategy to deter any attempts to usurp royal authority. The massive monuments of the Principal Group would have been a daily reminder of the king's ability to acquire labor and resources and would also have linked him to a long line of powerful rulers through a social consciousness of the city's history. On the other hand, the results may instead reflect strong social ties between the ruler and the elite. Strong visual ties between the king and nonroyal elite may have been used to forge social bonds and maintain social cohesion (Abercrombie et al. 1980), especially in the later years of the

Late Classic as the numbers of elite grew (W. Fash 2001). I argue that these two scenarios are not mutually exclusive and that perhaps Ruler 16 used visibility both to send messages of power and to establish social ties between himself and other elite.

Visual Prominence and Visual Connectedness of Copán's Residential Sites (Type 1–4)

Valley-wide: The valley-wide visibility results indicate the presence of a visual hierarchy in which elite complexes were, in most cases, more visually prominent than commoner households. While the valley-wide visibility values for type 2 and 3 sites are basically indistinguishable, I contend that these data are somewhat misleading. Three lines of evidence support my argument.

First, the visibility results at the three smaller analytical scales indicate that type 3 sites have strong visual ties to many of Copán's inhabitants suggesting that some variation was muted or masked at the valley-wide scale (the largest analytical scale). In other words, the smaller analytical scales revealed that type 3 sites had high visual prominence in more localized interaction spheres.

Second, the access results clearly indicate a problem with the Harvard Site Typology's classification of type 2 and 3 sites. I argue in Chapter 6 (and further pursue this argument in Chapters 8 and 9) that some type 2 sites are misclassified. Given that several type 2 sites are currently considered dominant households and exhibit some characteristics of elite architectural complexes, such as dressed stone (W. Fash 1983a; Leventhal 1979; Webster et al. 2000), I contend that if the Harvard Typology is used, that some type 2 sites are "underclassified" and should be reclassified as type 3 sites.

Third, while only 55.5% of people living at type 1 sites could see the Principal Group, nearly 75% of people living at type 2 sites could see those structures. This marked difference provides another line of support for the argument that some type 2 sites are "underclassified." It is possible that by reclassifying some type 2 sites to type 3, the visibility values for type 3 sites will be driven higher and thus designate a clear visual hierarchy at the valley-wide scale.

Urban Core−Hinterland: The urban core−hinterland results refine the valley-wide data. By subdividing the valley into two discrete analytical units, some of the variability masked at the valley-wide scale is revealed. In the urban core, elite complexes were more visually prominent than commoner households; however, the reverse pattern existed in the hinterlands. The results suggest that Copán's urban elite used the visibility of their households to differentiate themselves from commoners but did not employ this strategy in the hinterlands. The findings may reflect less social inequality and/or social tension in the hinterlands that mitigated the need to send visual messages of power and class distinction. In other words, there were distinct differences in urban and hinterland sociopolitical organization, in which people living in the urban core experienced greater sociopolitical control than people living in the hinterlands.

Physiographic Zones: The physiographic zone results suggest that people living in Zones 2, 3, and 4 maintained the strongest visual ties to the elite. In contrast, people living in Zone 5, the western part of the valley, had strong visual ties to people living at type 1 sites. These data refine the urban core−hinterland findings by highlighting an east-west spatial division that reflects a higher degree of sociopolitical control in the central and eastern parts of the valley than in the western part. At first glance, the fact that the physiographic zone data identified type 3 sites as the most visually prominent site type seemed erroneous; however, the sub-community data confirm these results.

Sub-communities: The sub-community visibility data support and refine both the urban core–hinterland and physiographic zone results. The smaller analytical units highlight differences within the broad categories of these larger analytical scales. Three patterns emerge from the sub-community data. The first two patterns indicate the presence of an east-west spatial division in the valley.

First, residents living in the western part of the valley were more socially isolated than people living in the central and eastern parts of the valley (Figure 7.8). Second, people living in western sub-communities had stronger visual ties to type 1 and type 2 sites (commoner households), while people living in the eastern sub-communities had stronger visual ties to type 3 and type 4 sites (elite complexes). Interestingly, the access data highlight a similar east-west division, in which sites in the eastern half of the valley were much more accessible than those in the west. Additionally, the access data indicate that people living in western sub-communities were not channeled to specific site types, while people living in the urban core and eastern part of the valley were channeled toward elite compounds. The access results combined with the fact that people living in western sub-communities had weak visual ties to elite sites supports the conclusion that people living in the western part of the valley experienced less sociopolitical control than people living in the urban core and eastern parts of the valley.

Third, type 3 sites maintained strong visual ties with the majority of Copán's sub-communities. Thus, while type 4 sites may have been seen by a larger number of people than type 3 sites (per the valley-wide results), this visibility was limited to specific sub-communities. In contrast, type 3 sites could be seen in more sub-communities. The fact that people living at type 3 sites maintained very strong visual ties to a larger number of sub-communities suggests that these sites may have played a specialized role in society perhaps as community shrines or administrative centers between higher status elite living at type 4 sites, who—according to the access data—had the highest degree of social connectivity with the king (Tables 6.57, 6.59, and 6.61).

Ultimately these results indicate the answer to the second question posed at the beginning of this chapter: *Did differences in the visibility of site types exist at different locations in the valley?* The answer to this question and others of a similar vein is yes. However, as this research illustrates, the only way to address this question is to use a multi-scalar approach. By employing an iterative process moving from the largest scale to the smallest—valley-wide to physiographic zone to urban core-hinterland to sub-community—the variation muted or masked in larger scales could be identified at smaller scales. In turn, the data from the smaller scales offers information on intermediate and local level interaction spheres that helps to identify diversity within sociopolitical organization.

The next chapter builds on the visibility results by evaluating the role directionality may have played in establishing visual connections among specific locations and particular social groups. I analyze the magnitude and direction (cardinal or off-cardinal views) from the Principal Group, valley stelae, and forty-one dominant households dispersed across Copán’s twenty residential sub-communities to further investigate the role visibility played in ancient sociopolitical organization. In particular, I evaluate if the visual domains (fields-of-view) of dominant households were expansive and targeted large audiences, or if they targeted particular areas or site types in order to build on and refine some of the interpretations set forth in this chapter (Llobera 2003, 2006).

Chapter 8:

Directionality of Monumental Architecture and Valley Stelae

Over the past few decades, scholarly research has shown that the ancient Maya replicated cardinality at different scales across their built environment (Ashmore 1991; Houk 1996; Joyce and Hendon 2000; Maca 2002). Recent work at the Late Classic site of La Milpa, Belize, is the first to investigate the relationship between cardinality and visibility at an ancient Maya city (Hammond and Tourtellot 1999; Tourtellot et al. 1999). Archaeologists discovered lines-of-sight between the city's main ceremonial center and stelae placed at four outlying settlements, each located at a cardinal point. Their findings indicate that directionality (i.e., measures of cardinality and intercardinality) can help to elucidate the role cardinality played in site organization. Research at Copán indicates that the city's rulers arranged the Principal Group, select elite architectural complexes (Ashmore 1991), and the urban core in a quadripartite design correlated to cardinality (Maca 2002) to replicate Maya cosmological principles. For this study, the findings from La Milpa raise a new question: *Was there a similar connection between visibility and cardinality at Copán?*

In this chapter, I build on the scholarship from Belize to examine whether cardinal relationships, with respect to visibility, exist between Copán's civic-ceremonial center and outlying settlements. The directionality results indicate that there is not a connection between cardinality or intercardinality and the visibility of Principal Group monuments, valley stelae, or dominant households.

In addition to investigating cardinality, I also reconstruct the visual domains and lines-of-sight of seven Principal Group monuments. I do the same for Copán's seven valley stelae (those located outside the Principal Group) to empirically test three hypotheses set forth by other archaeologists to explain their function (Figure 8.1). These include: (1) Stela 10 and 12 were sun markers that identified the onset of the planting season (Morley 1920); (2) Stela 13, located at the valley's eastern entrance, was part of a line-of-sight communication system for relaying smoke signals to the Principal Group (W. Fash 2001); and (3) Stelae 13 and 19 served as territorial markers for the Copán polity (W. Fash 1983a, 2001).

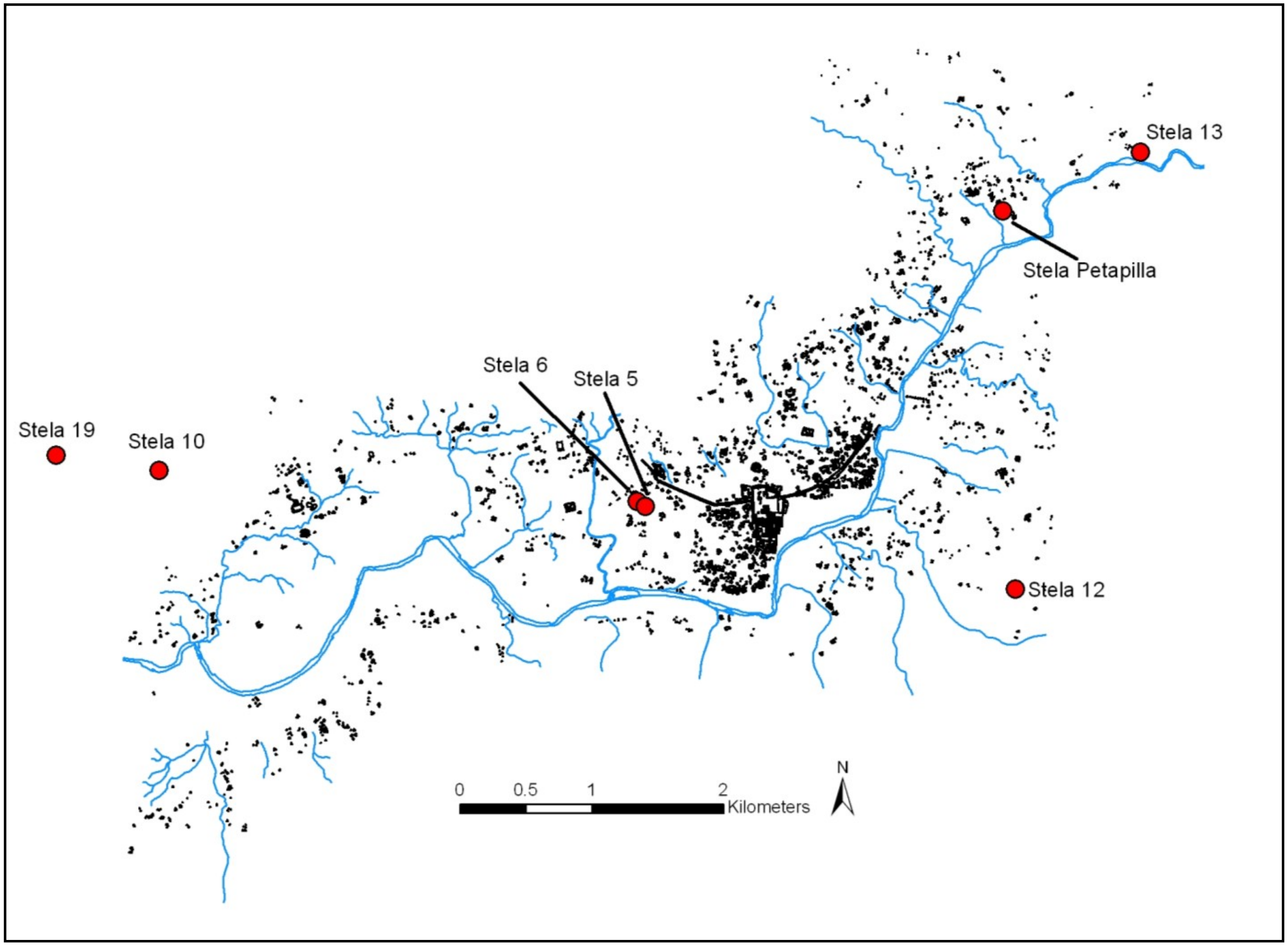


Figure 8.1: **Map illustrating locations of Copán's valley stelae**

To evaluate these hypotheses, I measured whether specific monuments were more visible in certain directions. While the results do not prove or disprove any of the hypotheses, they do provide data that led me to modify hypotheses 2 and 3. The data indicate that the Principal Group was not visible from Stelae 13 and 19, the two stelae presumably marking the eastern and western entrances of Copán. Perhaps Ruler 12 erected these two stelae in these locations to notify visitors that they were entering Copán's territory precisely because the city's main civic-ceremonial group was not visible until visitors traveled closer to the city's center.

Moreover, using the visibility and least-cost path data I propose two additional hypotheses to explain the function of the valley stelae—that they served as signposts for foreign visitors and/or stops along a procession route. Additionally, I measure whether the valley stelae targeted larger or different audiences to determine if they were disproportionately targeting the elite and to better understand the communicative roles of stelae at Copán.

Directionality of Viewsheds

Recent work on visibility in ancient landscapes suggests that archaeologists can use viewsheds to measure the direction and magnitude of views in order to reconstruct areas of visual overlap that may help to delineate different activity patterns, cultural groupings, or lines of communication flow (Llobera 2003, 2006). Chapter 7 focused on using viewsheds to measure (1) the visual prominence of Copán's different site types and (2) visual connectedness among the people living at these different site types. Chapters 8 and 9 focus explicitly on visual directionality, that is, in what direction(s) views were oriented, and builds on the visibility results presented in Chapter 7.

For the analysis, I measured the magnitudes of different views. Instead of measuring the sites' overall topographic prominence (the total number of visible pixels), I used the GIS tools to calculate the number of visible pixels in specific directions (refer to Chapter 5 for details of methods). The analysis was divided into cardinal (north, south, east, and west) and intercardinal (northeast, northwest, southeast, and southwest) views. I present the results in two formats—directionality maps and directionality graphs. Figure 8.2 shows the color scheme for the directionality maps. If, for example, a map shows an abundance of green, it signifies that the source site's view was directed towards the northwest. Table 8.1 lists the equivalents from 0° to 360° for each direction.

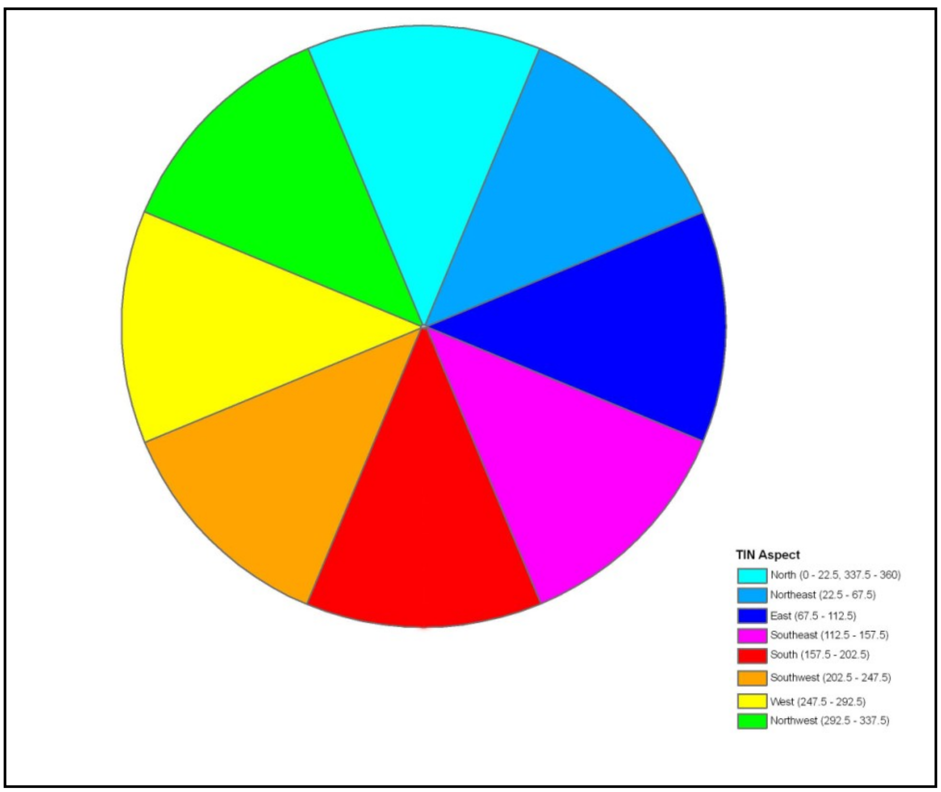


Figure 8.2: **Color scheme for directionality maps**

Table 8.1: ***Directionality equivalents in compass degrees for cardinal and off-cardinal directions***

Direction	Compass Degrees
North	0°–22.5°, 337.5°–360°
Northeast	22.5°–67.5°
East	67.5°–112.5°
Southeast	112.5°–157.5°
South	157.5°–202.5°
Southwest	202.5°–247.5°
West	247.5°–292.5°
Northwest	292.5°–337.5°

Using a subset of the viewsheds used in the visibility analysis, I created a set of directionality maps, also referred to as Higuchi viewsheds (Higuchi 1983; Maples 2004; Wheatley and Gillings 2000), for (1) seven monumental buildings in the Principal Group and the Royal Courtyard, (2) Copán's seven valley stelae, and (3) the proposed dominant household(s) in each of Copán's twenty residential sub-communities or *sian otots* (see Chapter 9 for dominant household results). Because most of the variation in directionality for the Principal Group monuments occurred in the near-distance zone (0−282 meters), rather than in the mid-distance zone (283−5170 meters), the Principal Group discussion focuses on the near-distance results. In contrast, the stelae results showed variation in the mid-distance zone, and thus the stelae discussion focuses on the data from this visual zone.

Visual Domains of Principal Group Buildings and Valley Stelae

Principal Group

In addition to analyzing directionality for dominant households in Copán's residential *sian otots*, I also evaluated directionality for seven monumental structures located in the Principal Group in order to determine if the visual domains of these buildings differed from one another in the late eighth and early ninth centuries. I also included Structure 10L-32, located in the Royal Courtyard and believed to be Ruler 16's residence (Andrews and Bill 2005), in the analysis. Given the importance of directionality in ancient Maya cosmology and of visibility in conveying power (Ashmore 1991; Coggins 1980; Houston et al. 2006), I wanted to test two things: (1) if specific buildings were more visible in certain directions and not in others and (2) if specific buildings targeted larger or different audiences.

The directionality maps indicate that six of the seven Principal Group structures had similar mid-distance visual domains. Structures 10L-11, 10L-16, 10L-18, 10L-21, 10L-22, and 10L-26 had 360° visual domains, i.e., they could be seen equally well from all directions outside of the urban core. In the near-distance visual domain, i.e., in the urban core, the Principal Group buildings targeted different audiences. All residents of the urban core could see structures 10L-11, 10L-16, and 10L-22 and these sites all had a 360° view of other sites in the urban core (Figures 8.3–8.5). All urban core residents, with the exception of people living in south El Bosque, could see Structure 10L-26 (Figure 8.6). Structure 10L-21 was visible to most urban residents, except for those living in eastern and southern areas of El Bosque (Figure 8.7). Structure 10L-18's urban core audience was slightly smaller than that of other Acropolis monuments, as only residents of western El Bosque, southern Las Sepulturas, and a few scattered households in Salamar could see it from their homes (Figure 8.8).

In contrast to the expansive visual domains of these Acropolis buildings, Structure 10L-4, a much smaller radial pyramid structure situated in the Great Plaza, had a relatively small audience. Interestingly, its visibility was much greater along the western *sacbe* than along the eastern *sacbe* (Figure 8.9). Moreover, it was visible from most of the stairs/benches in the Great Plaza, including the stairs and terraces of Structures 10L-11 and 10L-26, suggesting that its visibility was important for ceremonial events held in this area (Figure 8.10). Structure 10L-32, the royal residence, had a relatively large visual domain that encompassed residences throughout the urban core (Figure 8.11).

Although the near-distance views suggest that different structures may have targeted different groups within the urban core, the mid-distance views show no correlation between specific monumental buildings and particular groups of people or specific cardinal directions. The 360° mid-distance visual domains support the argument that the city's major civic-ceremonial monuments were meant to be seen by most of Copán's ancient inhabitants, with the exception of those living in the western part of the valley.

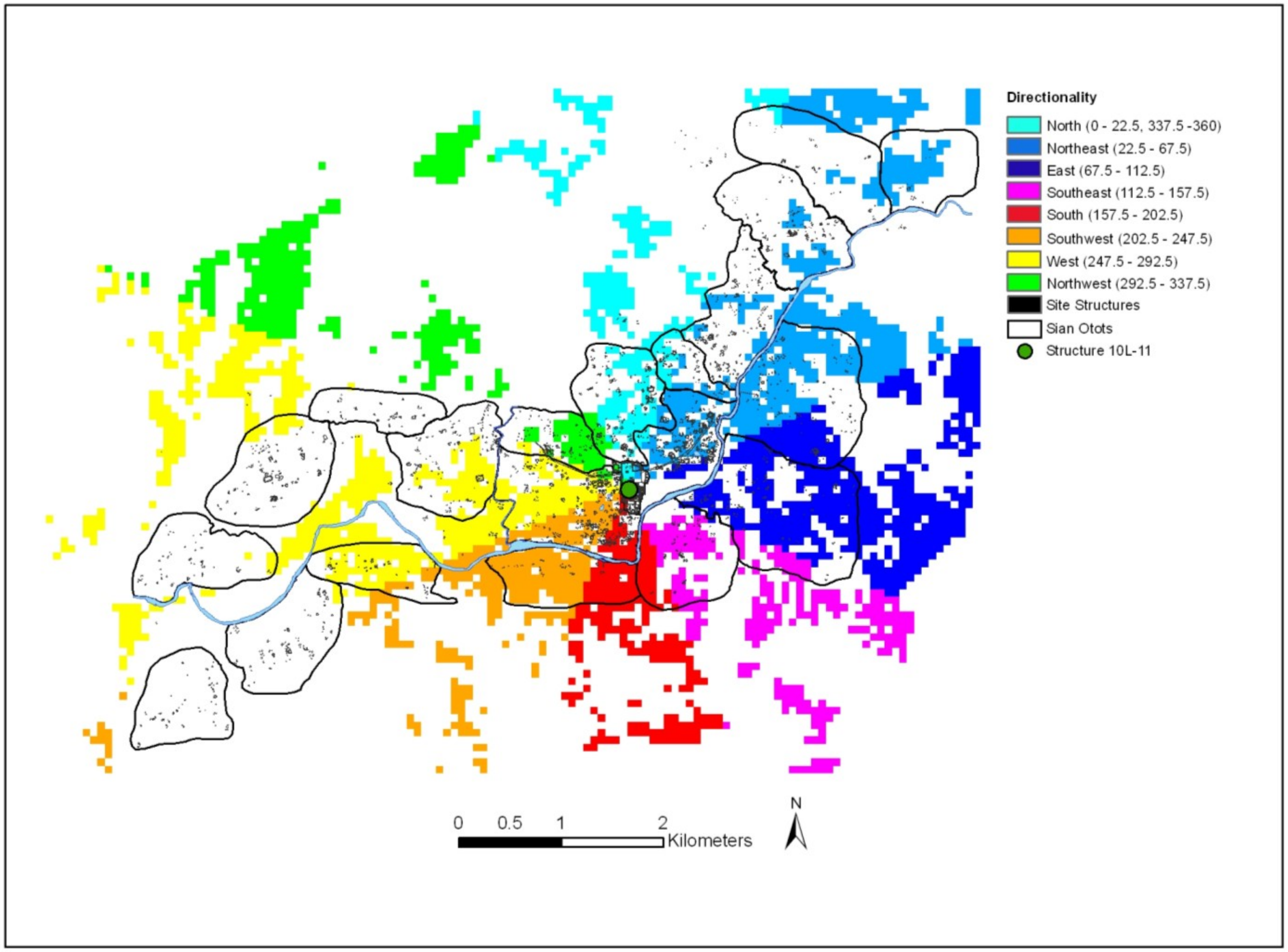


Figure 8.3: **Directionality map for Structure 10L-11, Acropolis, Principal Group, Copán**

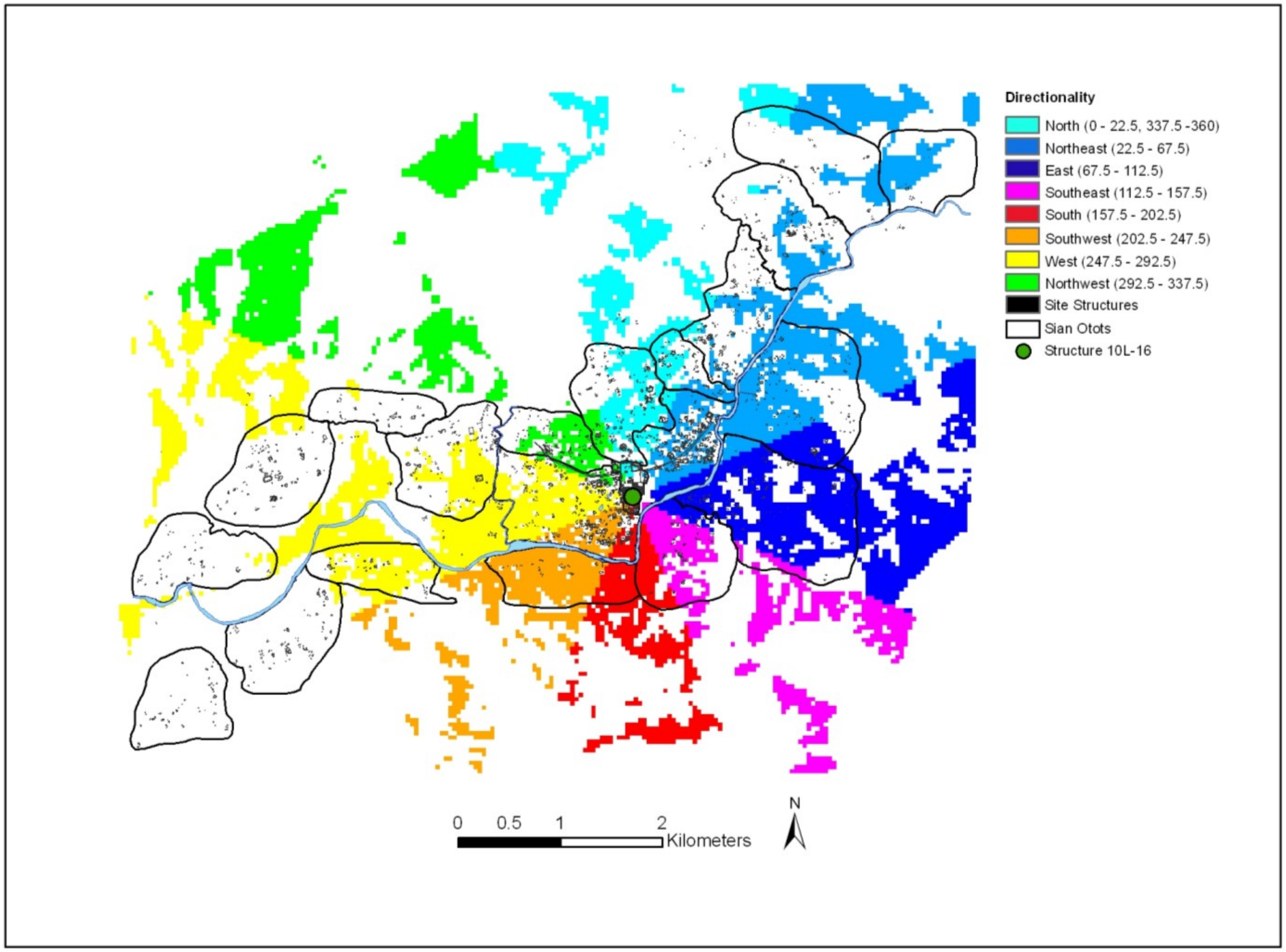


Figure 8.4: **Directionality map for Structure 10L-16, Acropolis, Principal Group, Copán**

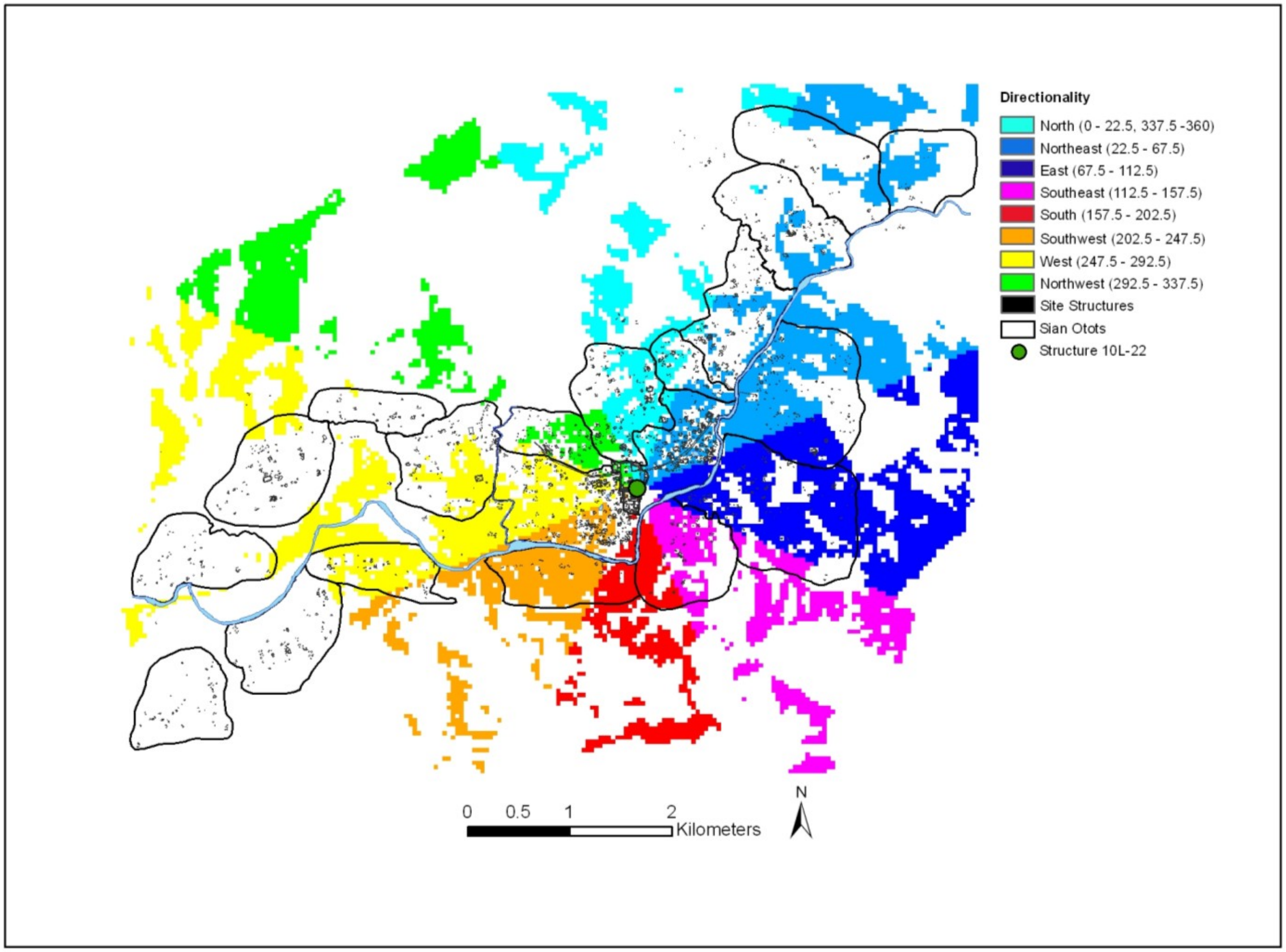


Figure 8.5: **Directionality map for Structure 10L-22, Acropolis, Principal Group, Copán**

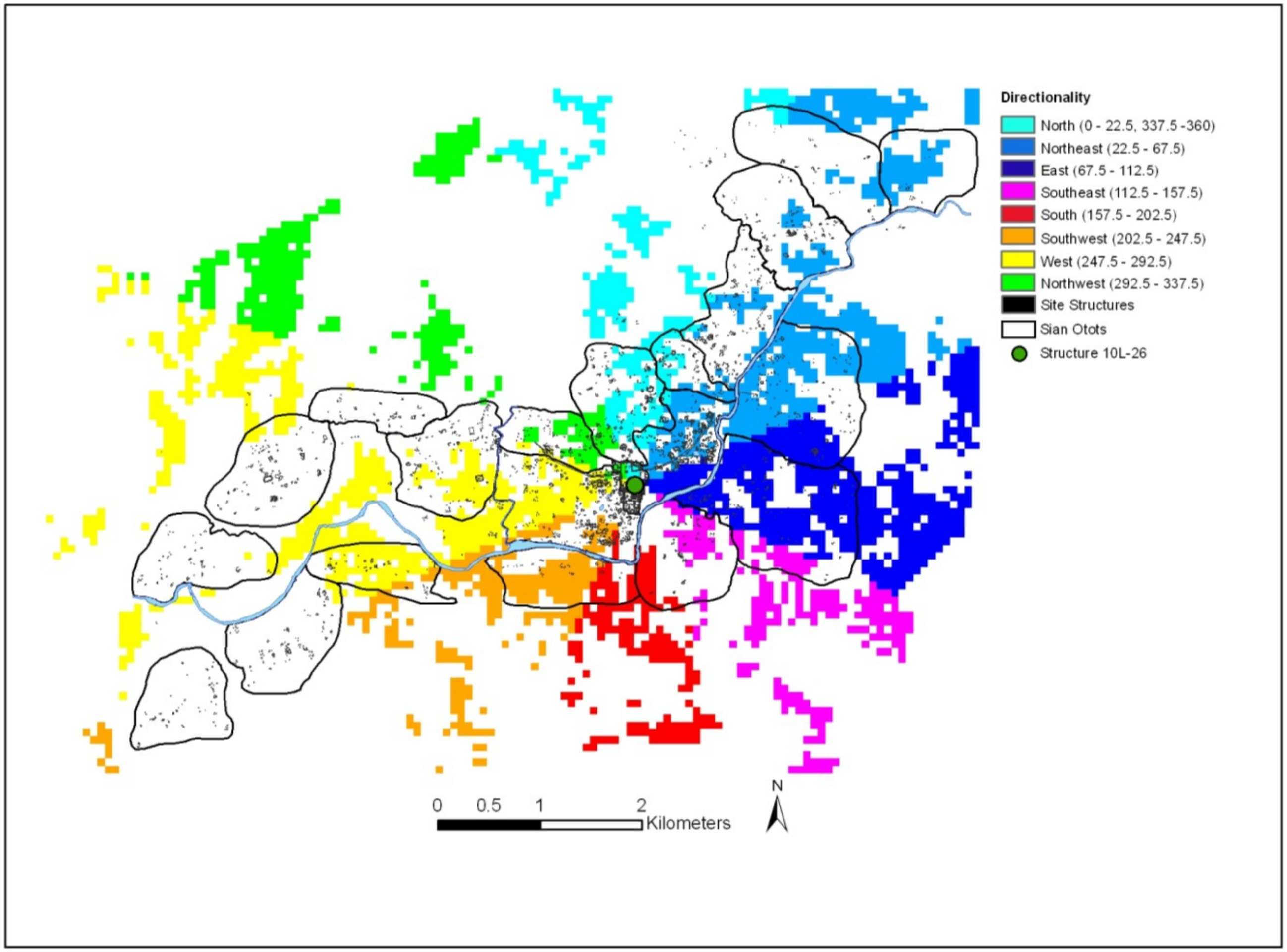


Figure 8.6: **Directionality map for Structure 10L-26, Hieroglyphic Court, Principal Group, Copán**

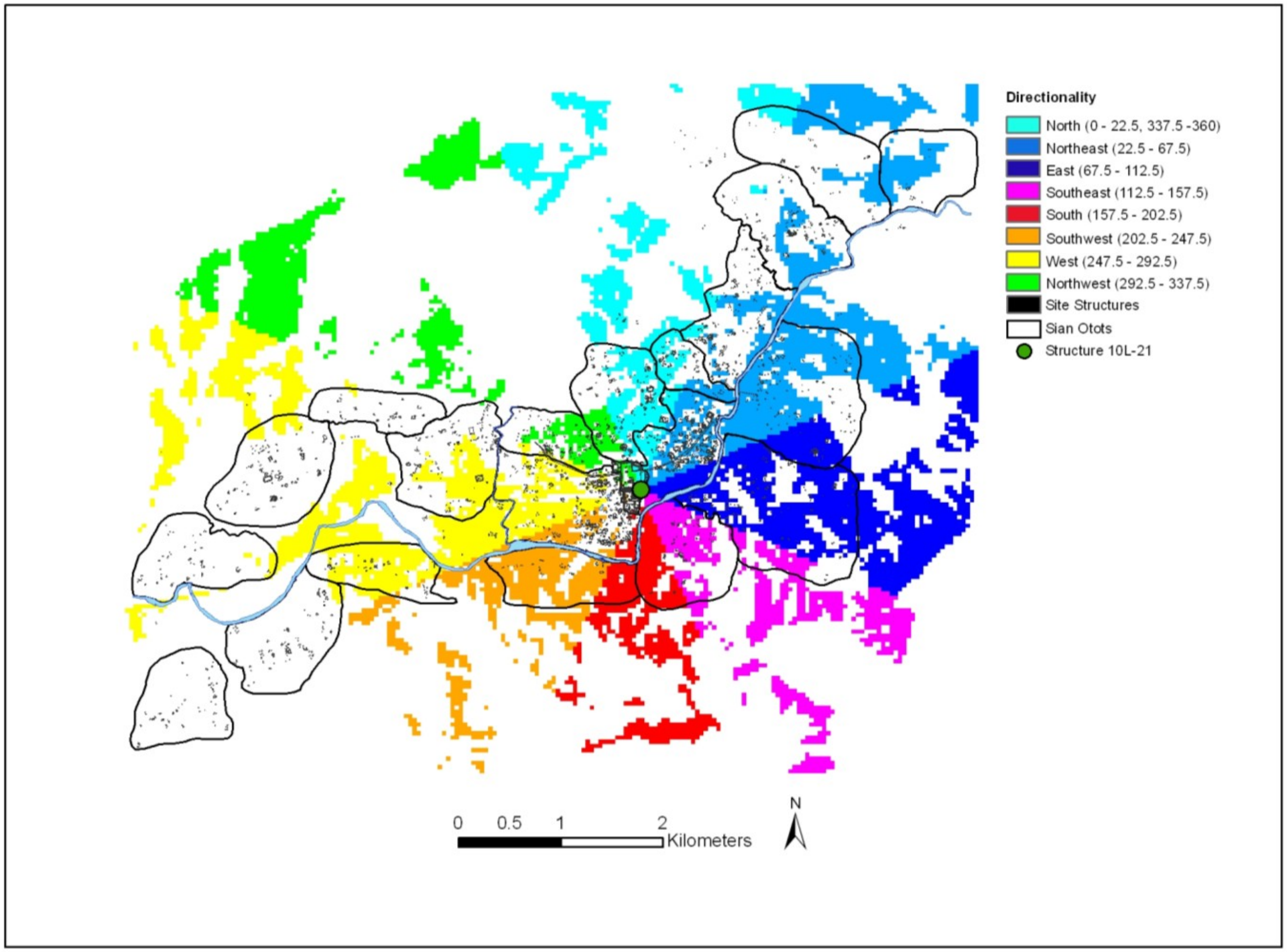


Figure 8.7: **Directionality map for Structure 10L-21, Acropolis, Principal Group, Copán**

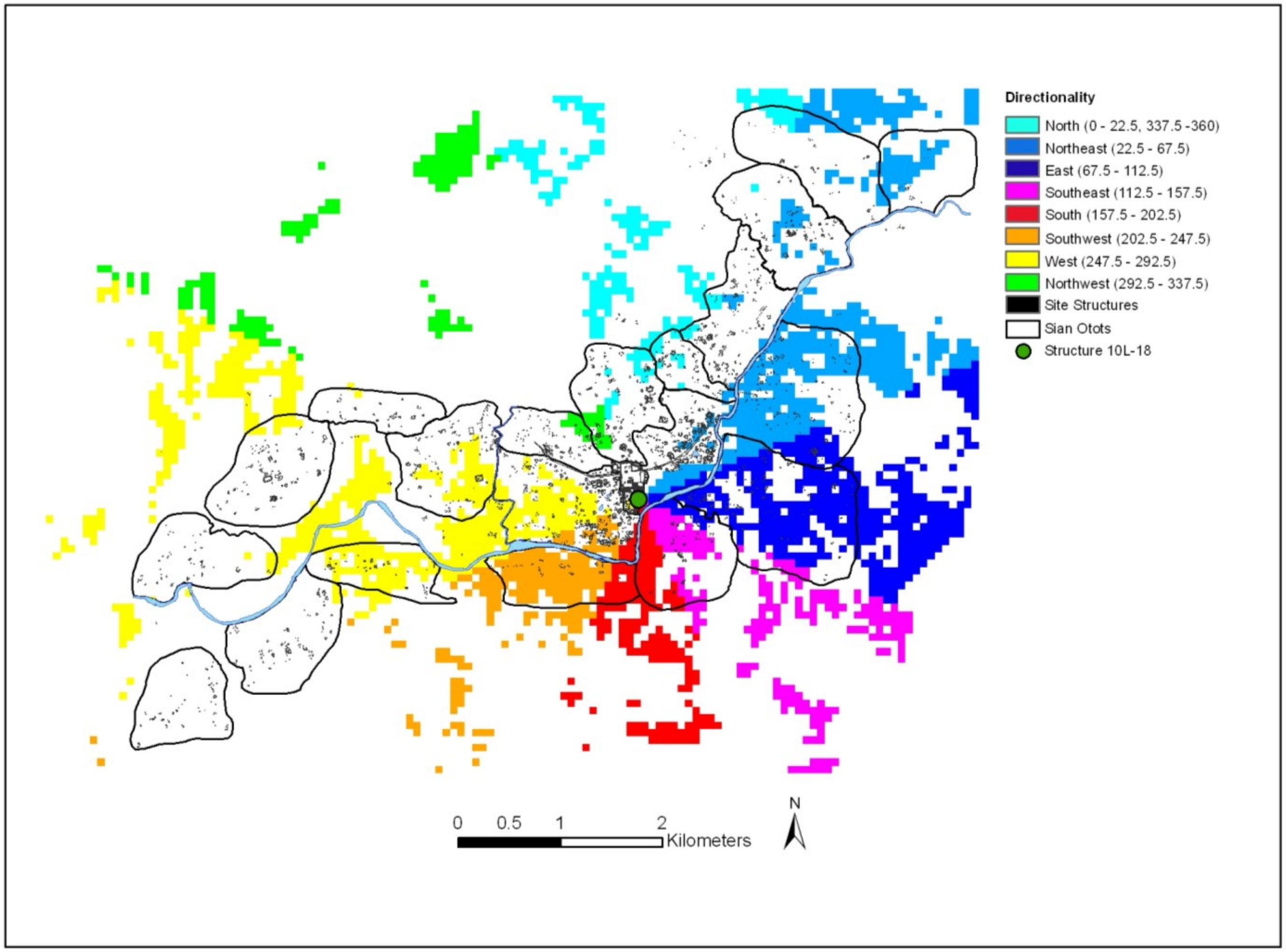


Figure 8.8: **Directionality map for Structure 10L-18, Acropolis, Principal Group, Copán**

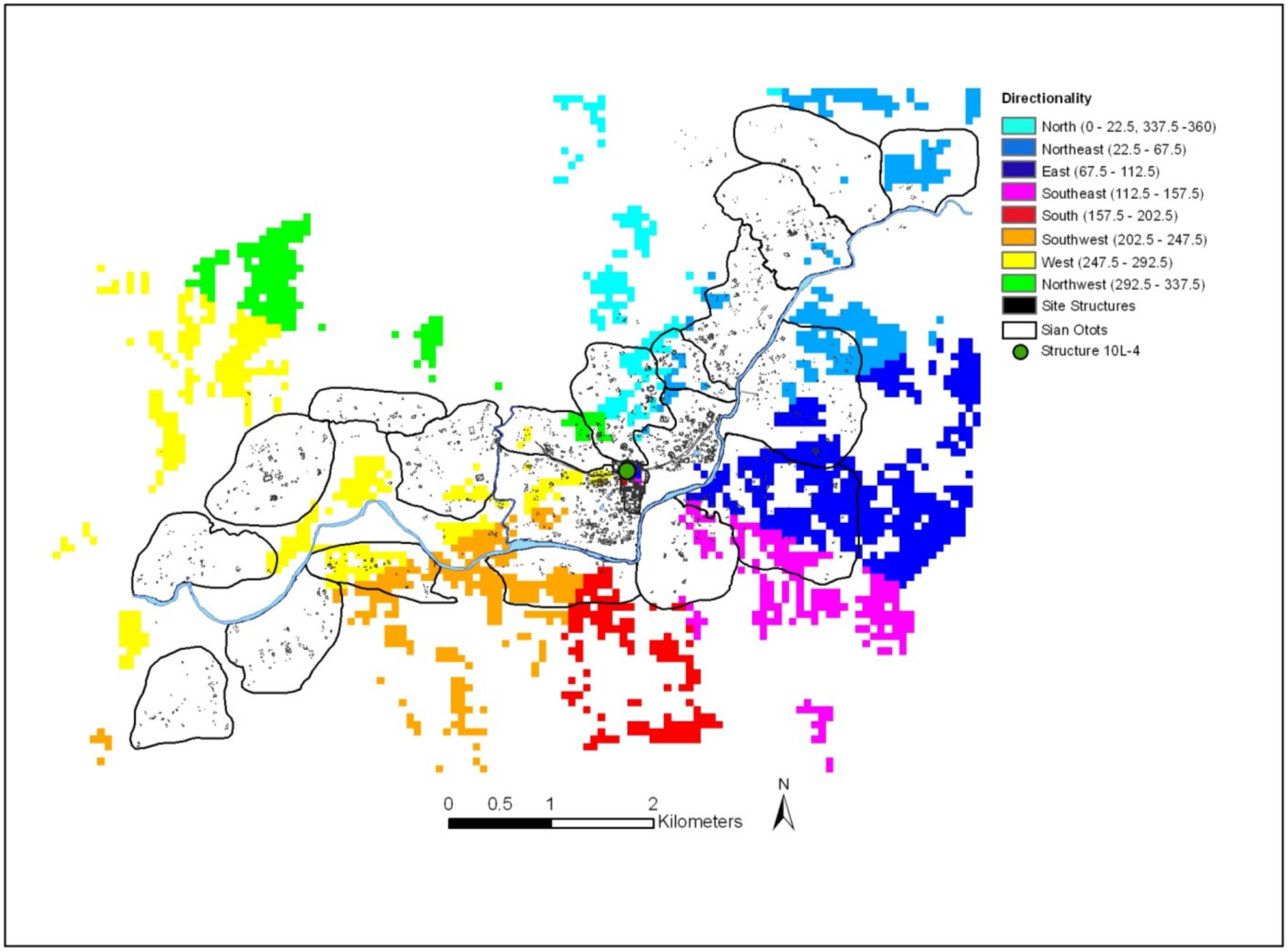


Figure 8.9: **Directionality map for Structure 10L-4, Great Plaza, Principal Group, Copán**

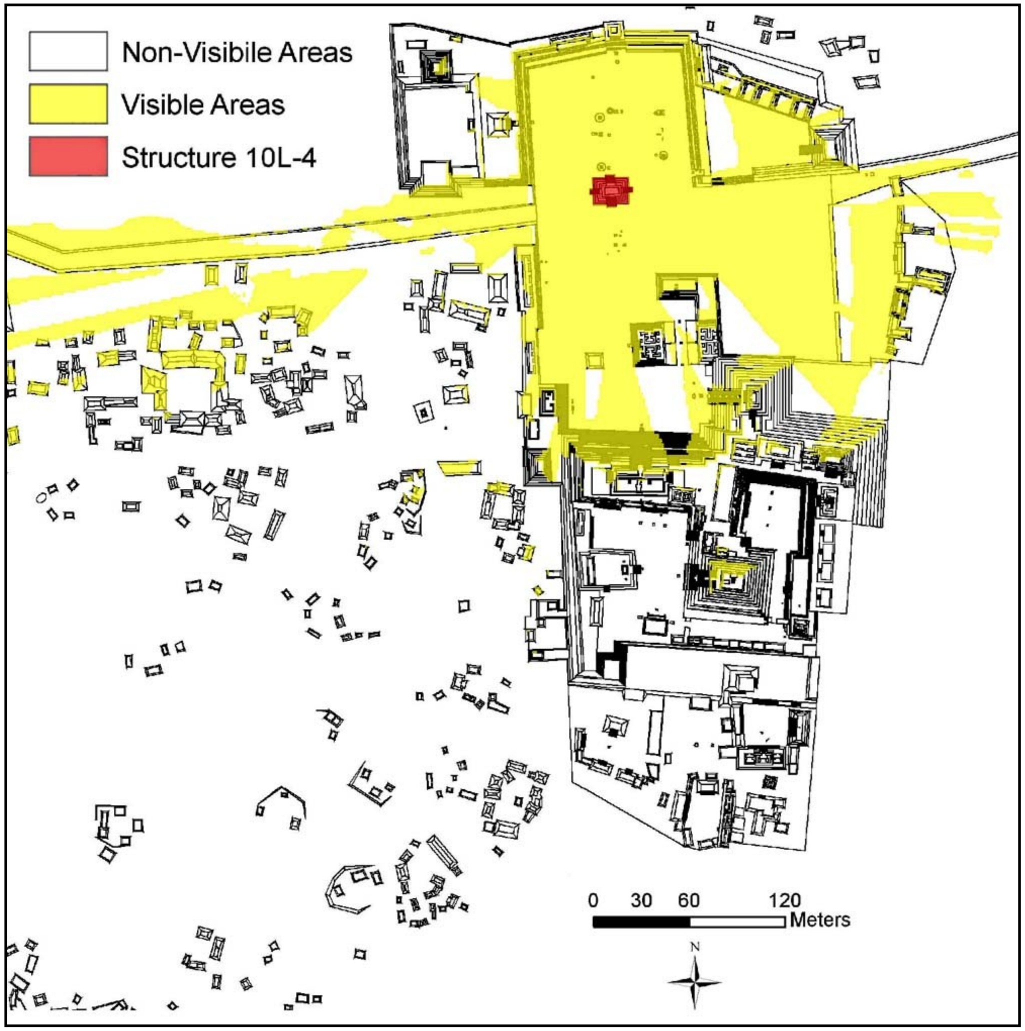


Figure 8.10: **Near-Distance visual domain for Structure 10L-4 in Great Plaza, Copán, Honduras**

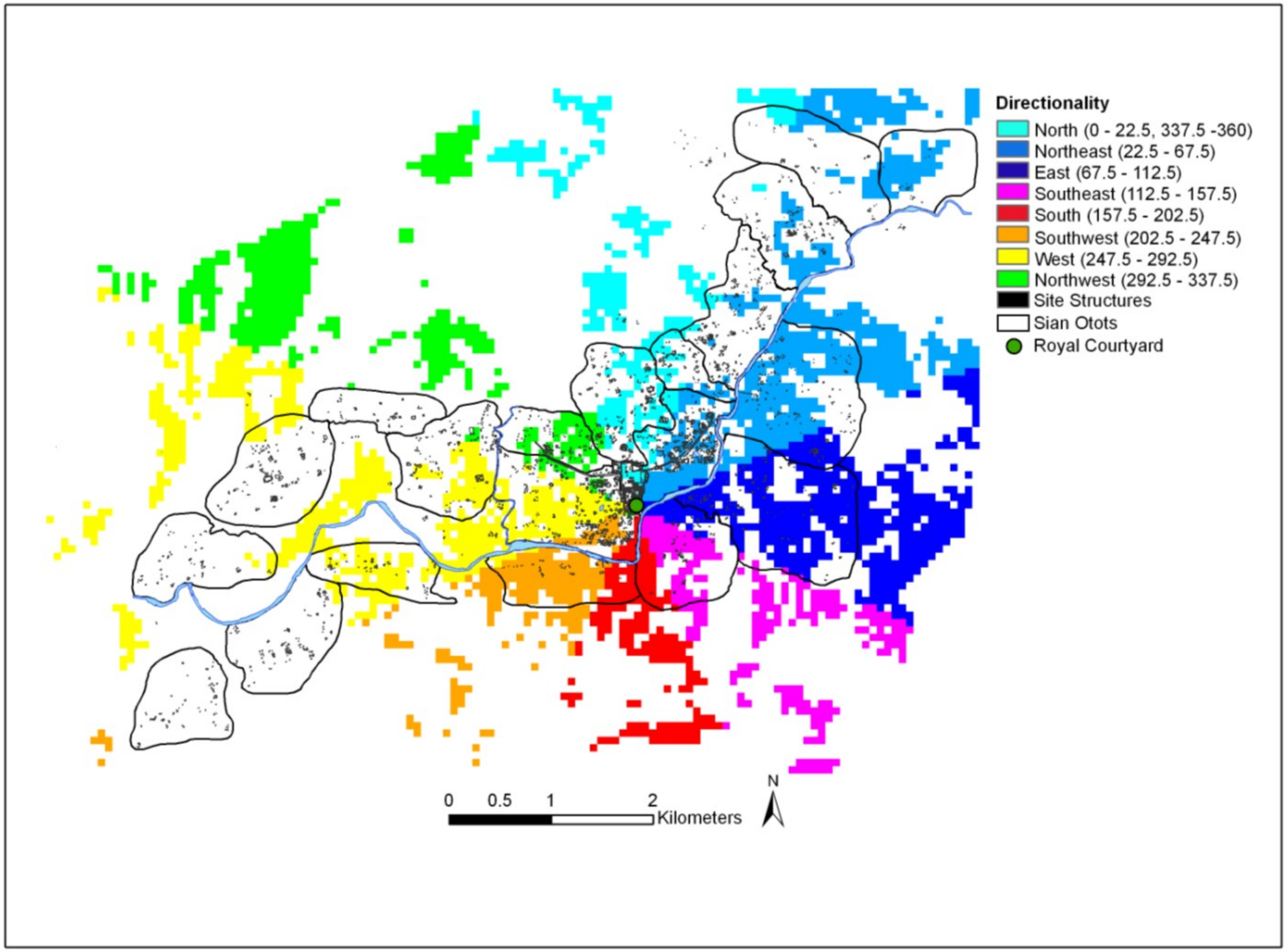


Figure 8.11: **Directionality map for the Royal Courtyard, Copán**

Visibility of Valley Stelae

Many scholars believe that the ancient Maya arranged stelae to establish lines-of-sight with other monuments, doorways, or other features. At La Milpa in Belize, archaeologists determined that the ancient Maya erected four suburban stelae in locations that maintained lines-of-sight with the tallest structure in the city's civic-ceremonial center (Hammond and Tourtellet 1999; Tourtellot et al. 2003; Tourtellot et al. 1999). At Quirigua, Guatemala, the ancient Maya apparently aligned all eleven freestanding monuments in the site's central complex to create lines-of-sight with at least two other freestanding monuments (Vogrin 1989). As for Copán, while Annegrette Vogrin (1989) has identified lines-of-sight between many of Ruler 13's Great Plaza stelae, other scholars have posited several hypotheses that revolve around the notion that lines-of-sight exist between some of the valley stelae and/or the Principal Group.

Hypothesis 1:
Sylvanus Morley (1920) argued that a line-of-sight existed between Stela 10 in the western half of the valley and Stela 12 in the east. He contended that the ancient Maya held ritual ceremonies at these two monuments that involved tracing the sun's path through the sky and their alignment with the sun on April 19, which marked the onset of the planting season.

Hypothesis 2:
William Fash (2001) hypothesized that Stela 13 may have served as part of a line-of-sight communication system between the eastern entrance and the Principal Group.

Hypothesis 3:
Several archaeologists (W. Fash 1983a; Marcus 1976; Spinden 1913) posited that Copán's valley stelae served as territorial markers, helping Ruler 12 to centralize power by delimiting his area of control, and that Stelae 13 and 19 marked the eastern and western entrances, respectively.

I argue that the effectiveness of such strategies necessitates that as many people as possible see these stelae. In other words, to effectively communicate power and control, these freestanding monuments needed to address a wide audience. Therefore, in this section I specifically address five questions: (1) *Did lines-of-sight exist between Copán's seven valley stelae*? (2) *Which valley stelae had lines-of-sight with the Principal Group?* (3) *Which valley stelae were most visually prominent?* (4) *From which* sian otots *were the valley stelae visible?* (5) *Did Copán's valley stelae address a larger percentage of elites or commoners?*

Question 1: Did lines-of-sight exist between Copán's seven valley stelae?

The visual domains presented in Figures 8.12−8.18 identify the presence or absence of lines-of-sight between Copán's valley stelae. Figures 8.12−8.14 indicate that Stela 13, Stela 19, and Stela Petapilla were not visible from any of the other valley stelae. In contrast, Figures 8.15−8.18 show that the other four stelae did have lines-of-sight to at least one other valley stela. The lines-of-sight are as follows: (1) Stela 5 to Stelae 6 and 12, (2) Stela 6 to Stelae 5 and 10, (3) Stela 10 to Stelae 6 and 12, and (4) Stela 12 to Stelae 5 and 10.

The existence of these lines-of-sight supports hypothesis 1, which posits that Stela 10 and 12 were sun markers. Morley (1920) contends that one day a year the sun rises directly behind Stela 12 and sets directly behind Stela 10 to mark the onset of the planting season. For this phenomenon to occur, a line-of-sight needs to exist between Stelae 10 and 12. My results indicate a line-of-sight between these two stelae, and while the results do not prove hypothesis 1, they do provide new GIS-based quantitative data suggesting that it is a viable explanation.

In addition, these data offer a new interpretation for the positioning of four more of the valley stelae. Figure 8.19 shows that the lines-of-sight between Stelae 5, 6, 10, and 12 form a triangle. Despite the fact that Stelae 5 and 6 are situated within 70 meters of each other, there is no line-of-sight between Stela 5 and Stela 10 (in the western part of the valley), and there is no line-of-sight between Stela 6 and Stela 12 (in the eastern part of the valley). Perhaps the close proximity of Stela 5 and Stela 6 relates in some way to the lines-of-sight triangle pattern, which would not exist if either Stela 5 or Stela 6 were removed, because one edge of the triangle would be missing. The lines-of-sight along this triangle serve to unite east and west to the valley center and may have had cosmological meaning.

According to Wendy Ashmore (1986, 1989) and Clemency Coggins (1980), "the addition of elements on east and west to form a triangle with the north, and frequent suppression of marking the southern position" (Ashmore 1991), are part of a template of ancient Maya site-planning principles. Copán's triangle pattern conforms to this template, with stelae situated in the west, east, and north but none to the south. Scholars have linked this pattern to an ancient cosmological principle uniting the layers of the universe "via cycles of the sun, moon, Venus, and other celestial bodies" (Ashmore 1991:201). If Stela 10 and Stela 12 acted as sun markers, Stelae 5 and 6 may have formed the third part of a system that "united" the layers of the universe via the cycle of the sun marked by Stelae 10 and 12.

Finally, the preservation of the lines-of-sight between Stelae 5, 6, 10, and 12 from their initial erection in the mid-seventh century AD, through a massive population boom, and into the early ninth century suggests that several generations of rulers believed the maintenance of these sight lines was important. Archaeologists have posited that ritual activities held at the valley stelae were accompanied by smoking fires (W. Fash 1983a). The open lines-of-sight between these activity centers would have facilitated visual communication between these sacred locations and the city's civic-ceremonial center.

Question 2: Which valley stelae had lines-of-sight with the Principal Group?

Archaeologists suggest that lines-of-sight between the civic-ceremonial center and outlying stelae at the Late Classic site of La Milpa served as a mechanism of social integration between the city's urban core and the hinterlands (Hammond and Tourtellot 1999; Tourtellot et al. 2003; Tourtellot et al. 1999). Figures 8.14−8.18 show that the Principal Group structures, at least those in the Acropolis, could be seen from five of the valley stelae: Stela 5, Stela 6, Stela 10, Stela 12, and Stela Petapilla.

The visual connections between Copán's valley stelae and the city's civic-ceremonial group replicate the La Milpa pattern, not necessarily in its quadripartite design, but by establishing visual ties between the city center and stelae located in the southeastern, northeastern, and western parts of the valley (Figure 8.19). That the pattern does not conform to a quadripartite design may be due to topographic restraints, that is, the valley's east-west orientation. If the goal, as at La Milpa, was to use lines-of-sight to connect the city center to distant suburbs, then a quadripartite design, while perhaps ideal, is ultimately unnecessary.

These same data also help to investigate hypotheses 2 and 3, which seek to explain why Ruler 12 erected these seven stelae. Hypothesis 2 suggests that Stela 13 served as part of a line-of-sight communication system between the eastern entrance and the Principal Group. However, Figure 8.12 indicates that while standing at Stelae 13, presumably marking entrance to Copán, the ancient Maya could not see any of the Principal Group monuments, nor in fact many of the valley sites. While it is possible that the ancient Maya used smoke signals or fire to communicate between Stela 13 and the Principal Group, as William Fash (2001) posits, a line-of-sight between the two would have made such a communication system easier and more efficient.

Hypothesis 3 states that the valley stelae were territorial markers delimiting the polity's boundaries, and that as part of this system Stelae 13 and 19 marked the valley's eastern and western entrances. Figures 8.12 and 8.13 indicate that the viewsheds of Stelae 13 and 19 were small and in fact overlapped with very few valley sites. While the viewsheds of both of these stelae may be focused outside the Copán Valley (the DEM is limited to the valley boundaries) to notify approaching visitors that they were entering Copán's territory, the effect would have been greater if visitors could have seen the valley's impressive Principal Group monuments and large valley settlement as they entered the valley.

However, another way to interpret these results is to suggest that if these stelae marked the boundaries of Copán, then perhaps one of the reasons that Ruler 12 erected them relates to the invisibility of the Principal Group at the polity's boundaries. In other words, precisely because visitors entering Copán’s territory could not see the city’s major civic-ceremonial group until they traveled closer to the city’s center, Ruler 12 needed another way to delineate the city’s boundaries.

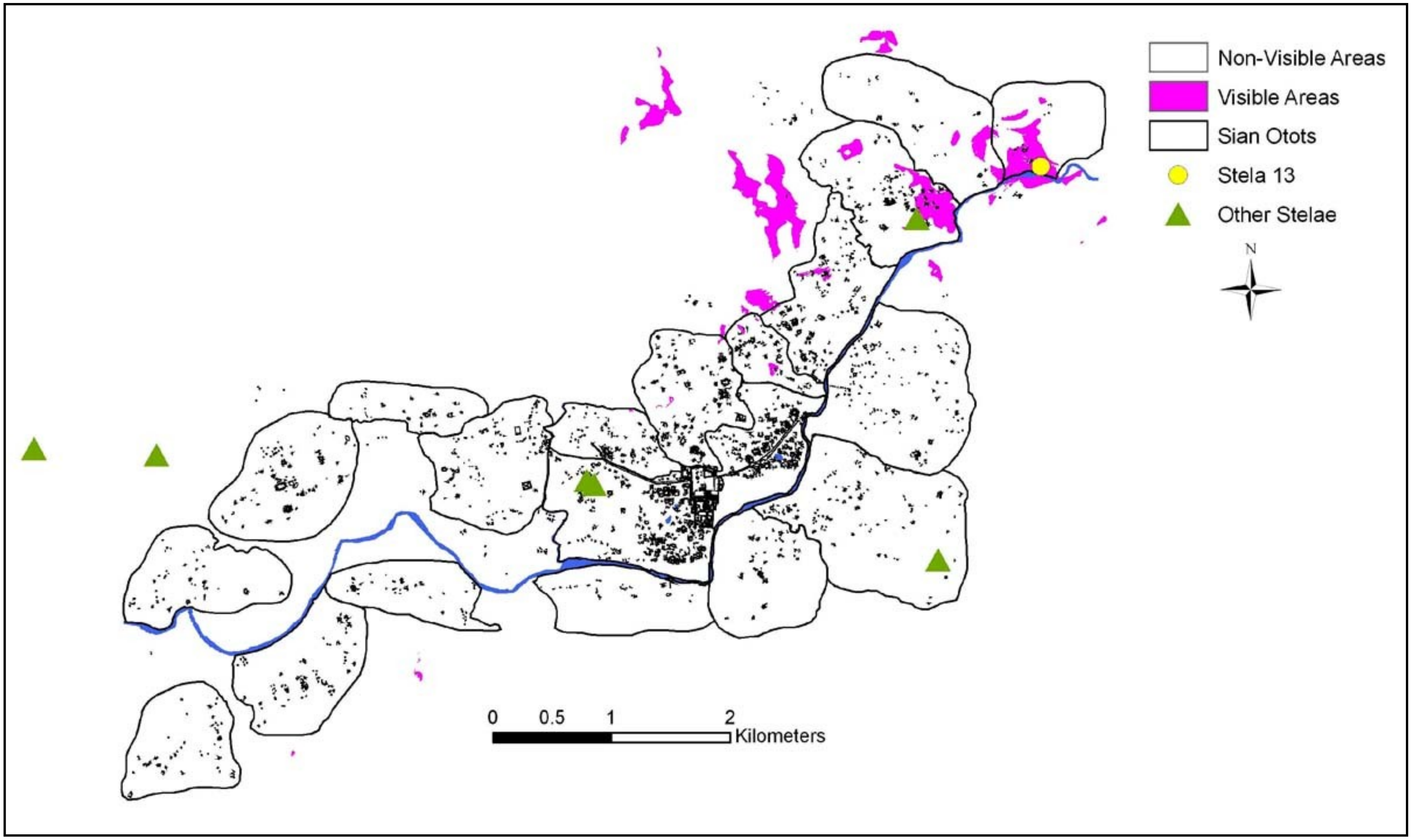


Figure 8.12: **Viewshed of Stela 13**

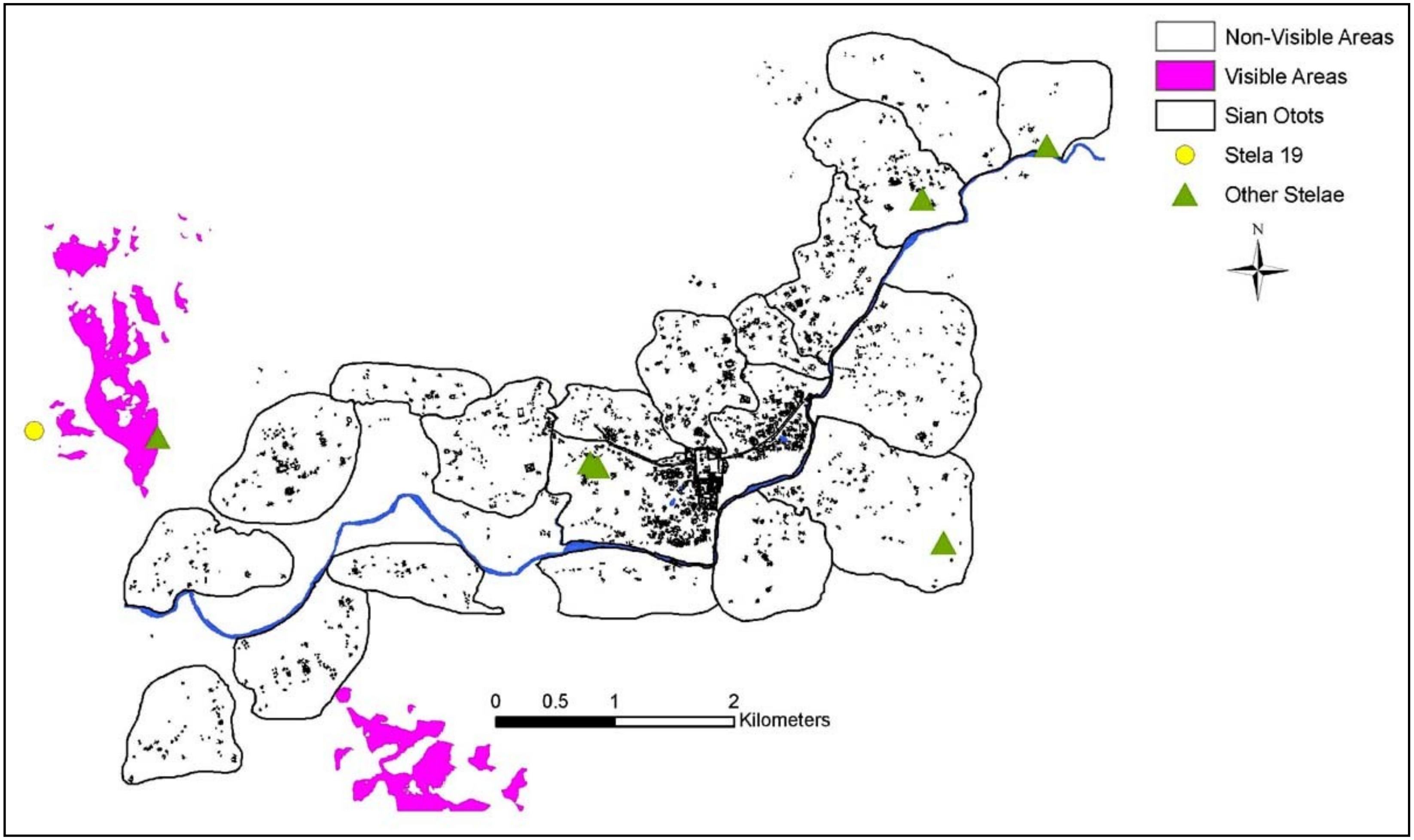


Figure 8.13: **Viewshed of Stela 19**

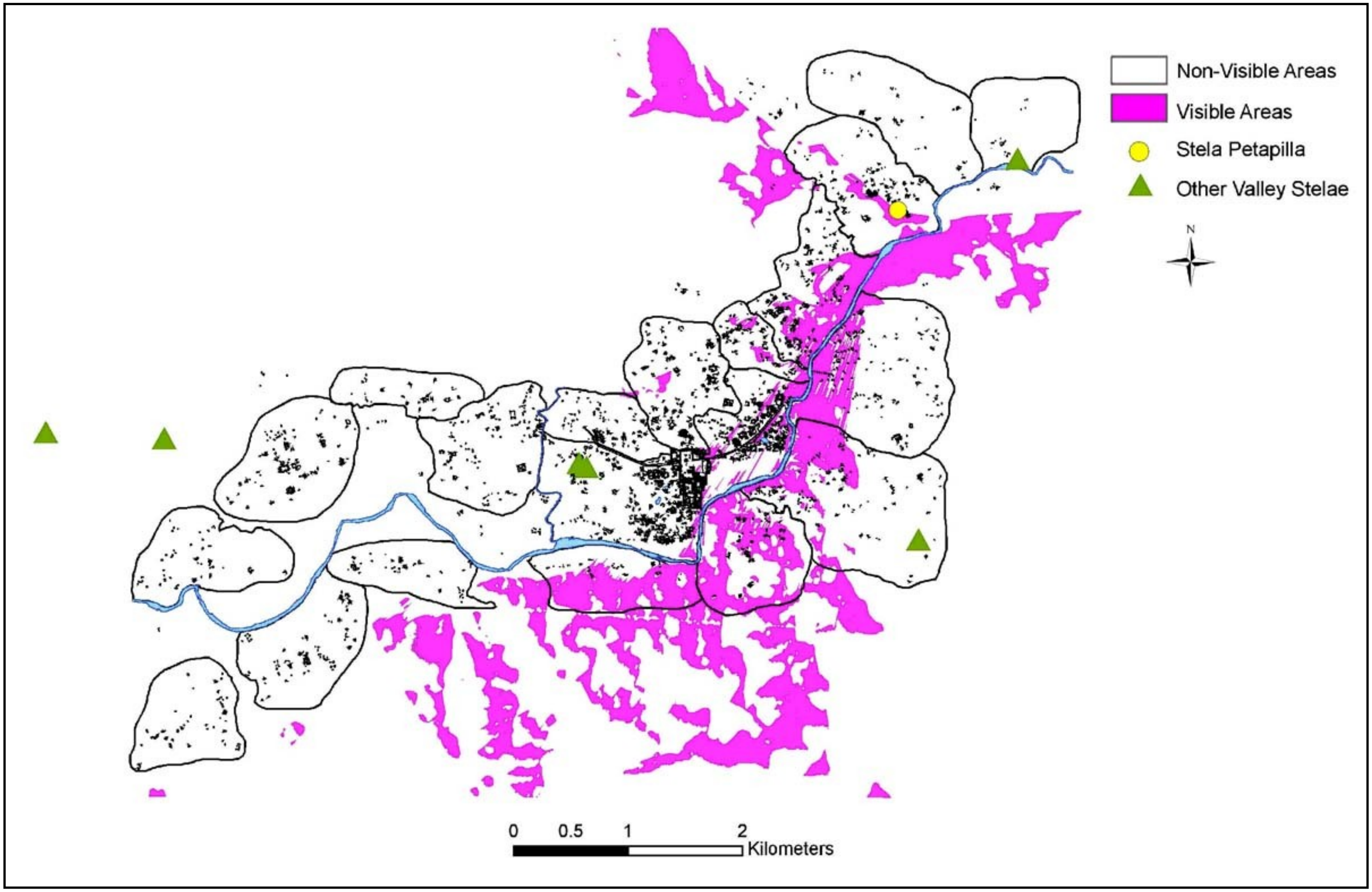


Figure 8.14: **Viewshed of Stela Petapilla**

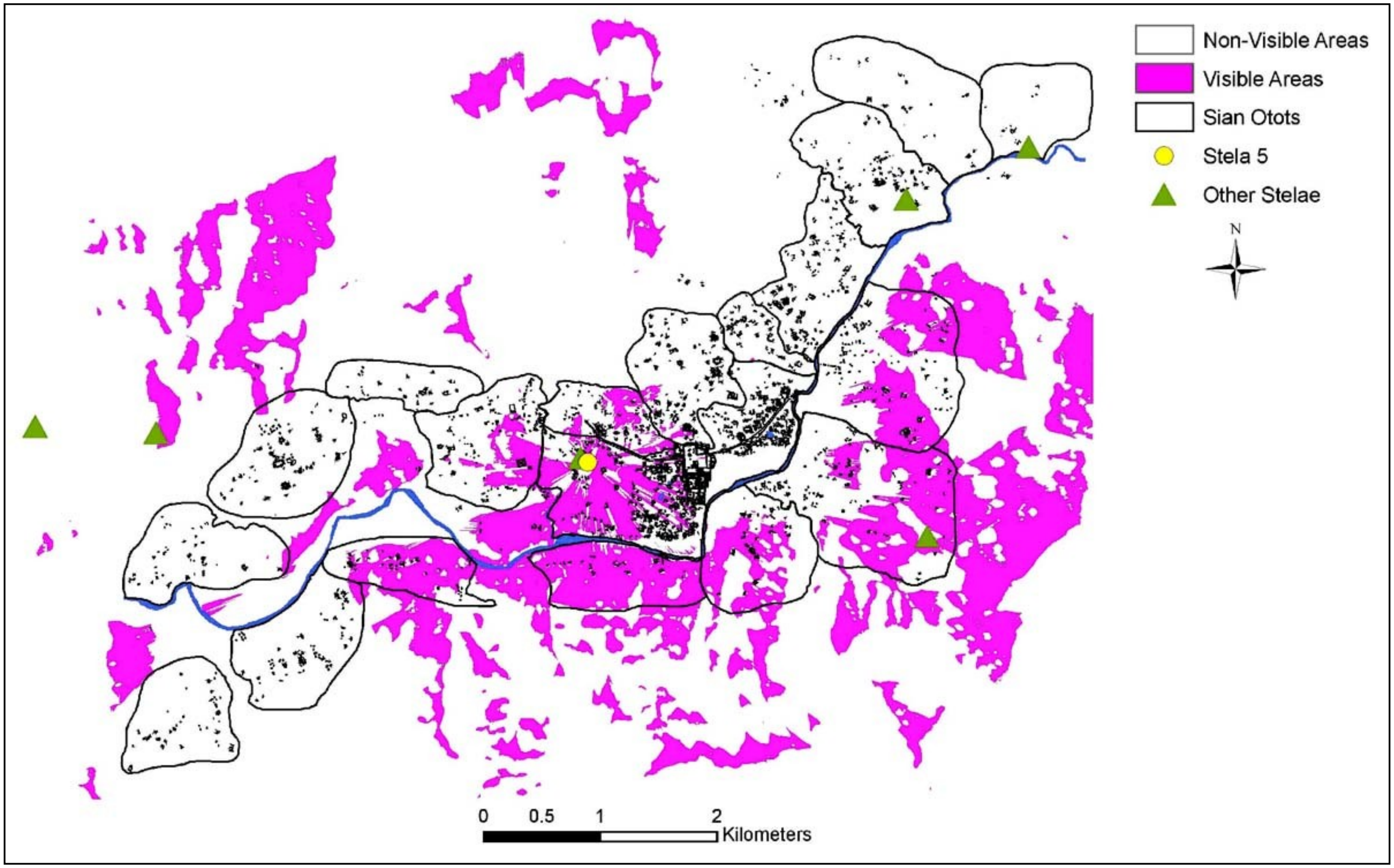


Figure 8.15: **Viewshed of Stela 5**

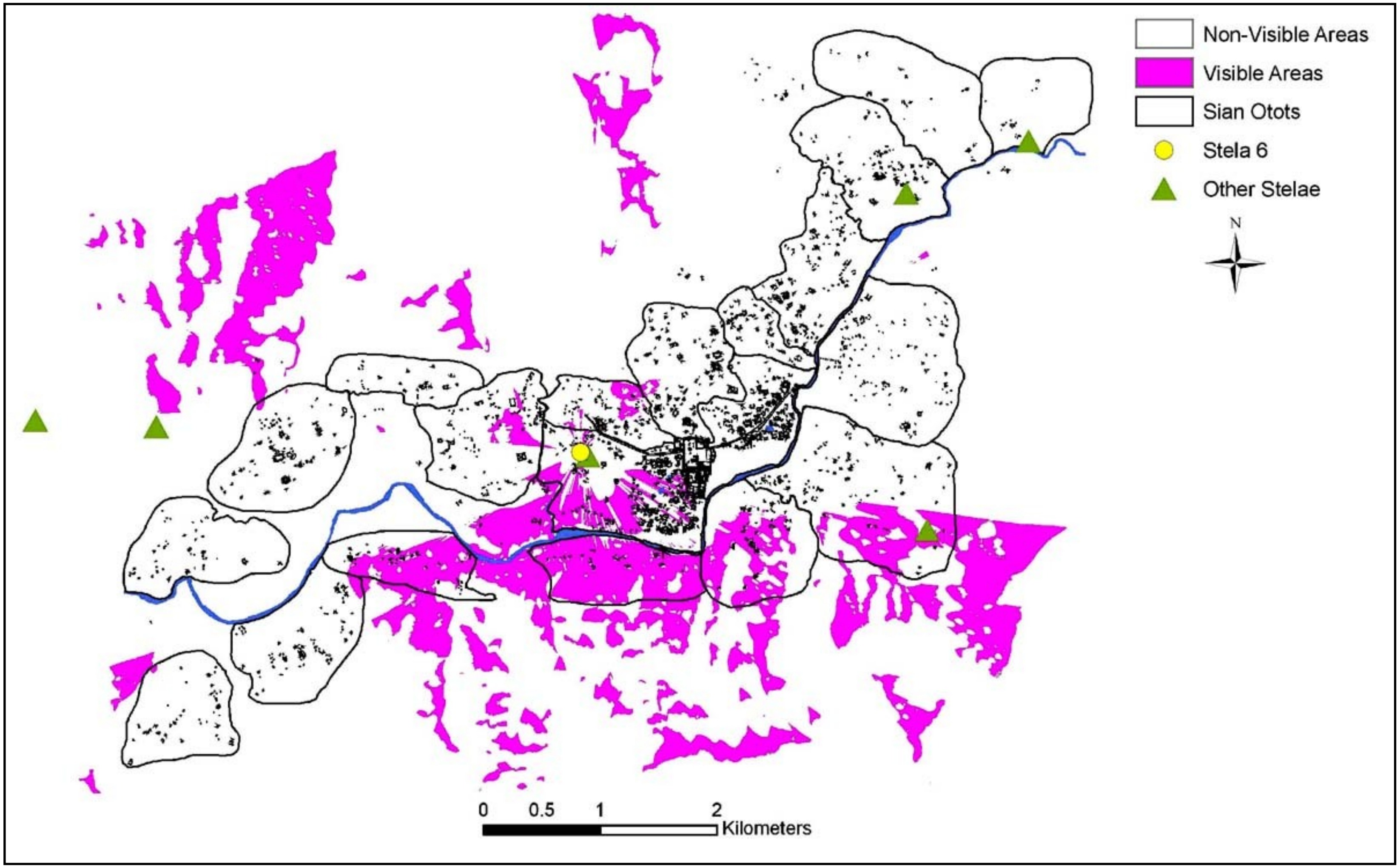


Figure 8.16: **Viewshed of Stela 6**

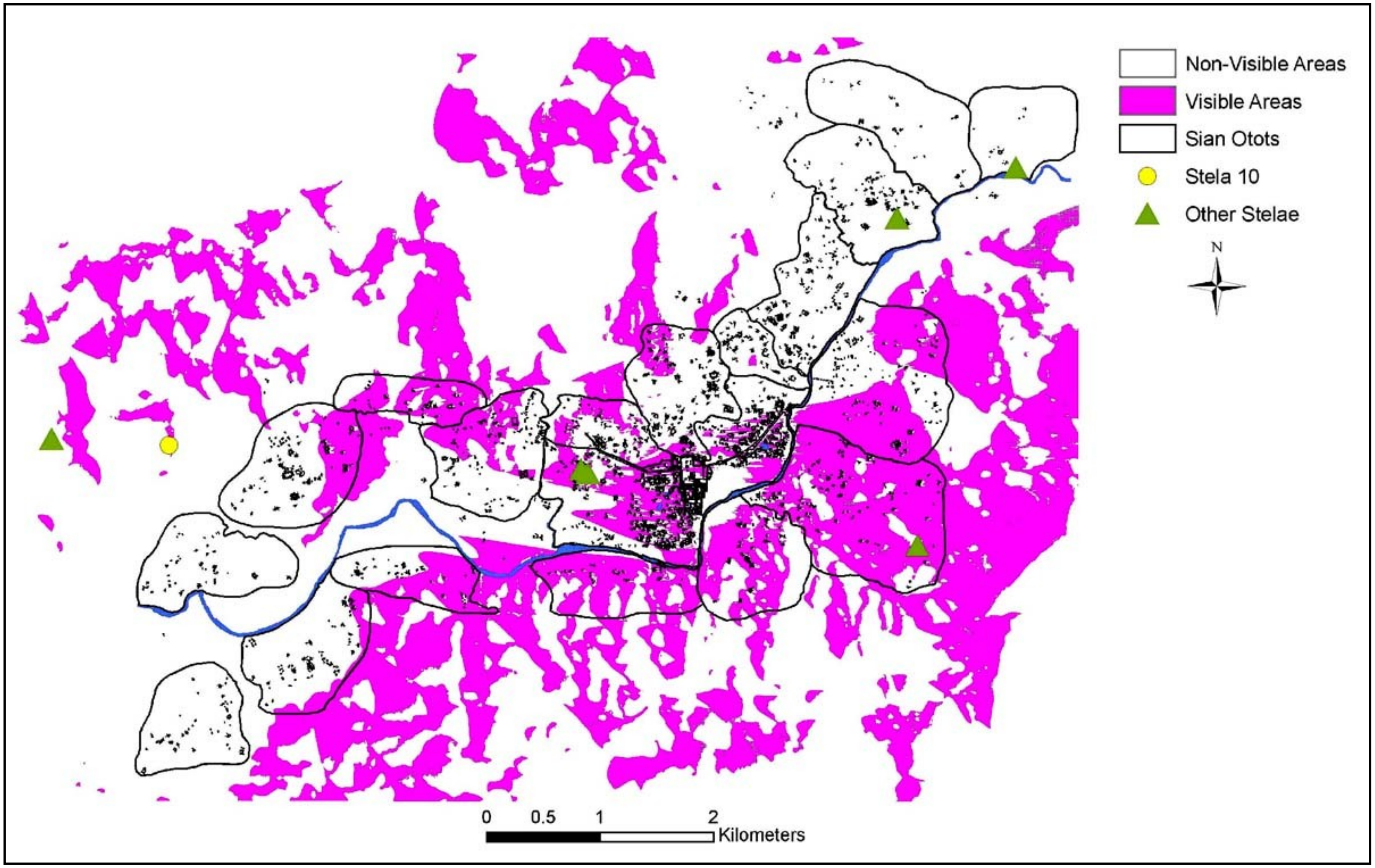


Figure 8.17: **Viewshed of Stela 10**

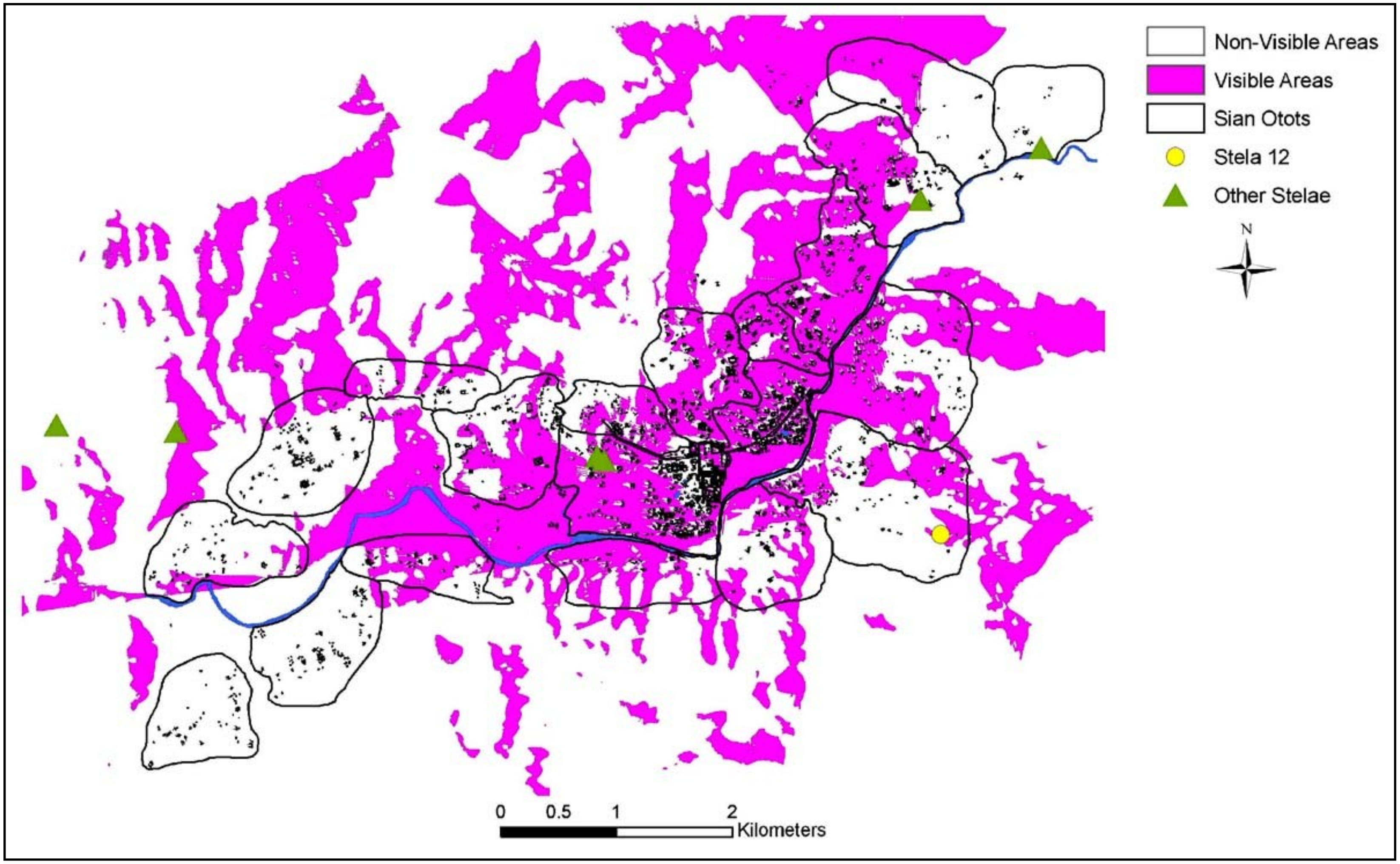


Figure 8.18: **Viewshed of Stela 12**

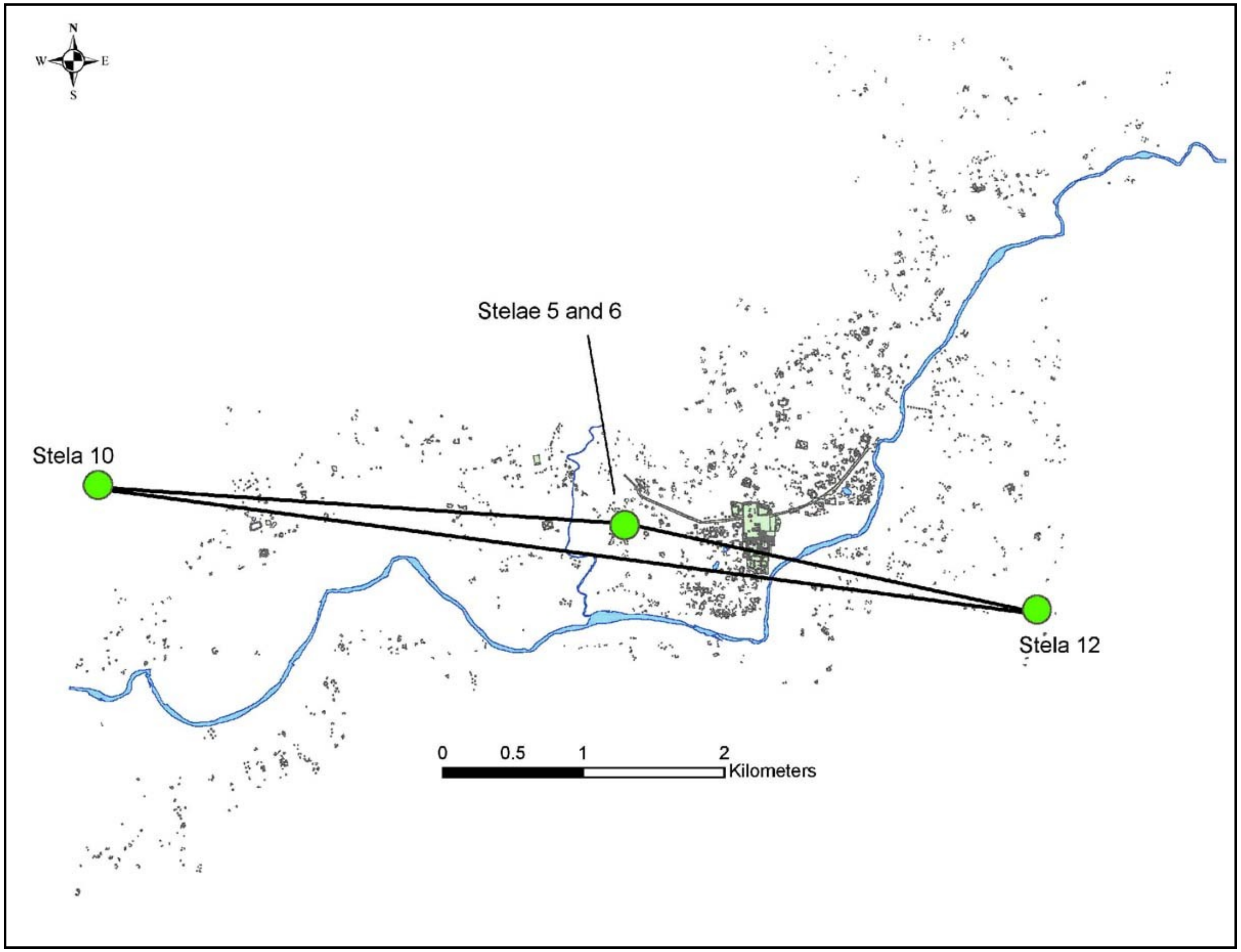


Figure 8.19: **Lines-of-Sight between Copán valley stelae**

Visual Prominence and Visual Connectedness of Valley Stelae

Lines-of-sight between Copán's stelae provide information on potential ties connecting ritual activities held at the valley stelae; however, they do not offer information on *how many people* and the purveyors of such ceremonies were targeting and who they were. To identify audience (receivers of messages), it is necessary to examine each stela's entire visual domain by creating maps that overlay each stela's viewshed with Copán's archaeological sites. The GIS maps in Figures 8.12−8.18 not only provide data on lines-of-sight between stelae, they also contain data to (1) determine the visual prominence of the valley stelae, (2) identify from which *sian otots* the valley stelae were visible, and (3) test whether the valley stelae addressed a greater percentage of elites or commoners.

Question 3: Which valley stelae were most visually prominent?

Table 8.2 provides data on two types of visual prominence: (1) percentage of the valley that could see each valley stela and (2) percentage of sites that could see each valley stela. The second type of visual prominence is important because it offers information on visual connectedness to people rather than simply unoccupied portions of the landscape.

The data in the table indicate that Stelae 10 and 12 were the most visually prominent. Although the percentages of visibility between the two stelae are not dramatically different for the valley as a whole, the results in the last column of the table show that Stela 12 was visible from almost 70% of households, almost 30% more sites than Stela 10. Moreover, residents (of at least one household) in sixteen of Copán's *sian* *otots* could see Stela 12, whereas Stela 10 was visible only to residents in twelve *sian otots*. When the visual domains of the two stelae are combined, only residents from Titoror and Tapescos, Copán's two most marginalized sub-communities, could not see at least one of these two stelae.

Table 8.2: ***Visual prominence of Copán's valley stelae***

Stela	**Visual Prominence−Valley-wide**	**Visual Prominence−Sites Only**
Stela 13	1.2%	2.86%
Stela 19	1.9%	0.00%
Stela Petapilla	8.9%	17.8%
Stela 5	15.5%	25.3%
Stela 6	10.2%	21.2%
Stela 10	25.6%	41.9%
Stela 12	27.6%	**69.9%**

Thus, if the ancient Maya held concurrent ritual ceremonies at these two stelae, as posited by Morley (1920), then most Copanecos could have gathered within their own sub-communities to watch them. By watch I do not necessarily mean that all people within the visual domains of these stelae could see distinct figures or ritual acts, but they would at least have had a clear line-of-sight, perhaps seeing smoke or fire, allowing them to indirectly participate in such events. The high visual prominence of these two stelae may have also functioned to remind the valley's inhabitants that their rulers were watching over them (Houston et al. 2006).

The results also highlight the extremely low visibility of Stela 13 and 19, the valley's far-western and far-eastern stelae. Given that Stela Petapilla had a much higher visual prominence than Stela 13 (17.8% compared to 2.86%) and was visible all along the river in the eastern part of the valley (Figure 8.14), the path most likely taken by visitors entering the valley from the east, perhaps Stela Petapilla, not Stela 13, served as a principal locale for William Fash's (2001) line-of-sight communication system notifying the city's center of eastern visitors. The same possibility holds for Stela 10 on the western front, which maintained a line-of-sight with the Principal Group and could be seen by many of the valley's inhabitants.

Question 4: From which sian otots *were the valley stelae visible?*

The data in Table 8.3 indicate that the civic-ceremonial structures of the Principal Group were visible from five (Stelae 5, 6, 10, 12, and Petapilla) of the seven valley stelae. These five valley stelae are spaced between 3 and 3.5 kilometers apart, with the exception of Stelae 5 and 6, which are separated by a distance of only 70 meters. Stelae 5 and 6, located approximately 820 meters west of the Principal Group, have similar visual domains overlooking the west-central and southern parts of the valley (Figures 8.15 and 8.16). Stela 5 was visible from ten *sian otots* and Stela 6 was visible from eight *sian otots*.

Stela 10, located in the northwestern part of the valley, was visible from thirteen *sian otots*, including those in and adjacent to the urban core as well as three *sian otots* located in the western part of the valley—Ostuman, Yaragua, and Algodonal (Figure 8.17).

Stela 12, erected in the southeastern part of the valley, could be seen from sixteen *sian otots,* indicating that it addressed the greatest number of sub-communities (Figure 8.18). Its visibility extended to all areas except for the far western and far northeastern corners of the site.

Residents living in eight *sian otots* could see Stela Petapilla, which was located in the northeastern part of the valley (Figure 8.14). The stela addressed residents living in nine sub-communities along the Río Copán in the eastern part of the valley.

Stela 13, also located in the northeastern part of the valley, approximately 1.1 km northeast of Stela Petapilla, was visible only from four *sian otots*, all of which are in Zone 3 within a 2.5-kilometer radius of the monument (Figure 8.12).

Table 8.3: *Visibility of valley stelae from Copán's* sian otots

Sian Otot	Stela 5	Stela 6	Stela 10	Stela 12	Stela 13	Stela 19	Stela Petapilla
El Bosque	yes	yes	yes	yes	no	no	no
Las Sepulturas	yes	no	yes	yes	no	no	yes
Principal Group	yes	yes	yes	yes	no	no	yes
Rastrojon	no	no	no	yes	yes	no	yes
Chorro	no	no	no	yes	yes	no	yes
Mesa de Petapilla	no	no	no	yes	yes	no	yes
Titoror	no	no	no	no	yes	no	no
El Pueblo	yes	yes	yes	yes	no	no	no
Bolsa de Petapilla	no	no	no	yes	no	no	no
Salamar	no	no	yes	yes	no	no	no
Comedero	yes	yes	yes	yes	no	no	no
San Rafael	yes	yes	yes	yes	no	no	yes
El Puente	yes	yes	yes	yes	no	no	yes
San Lucas	yes	yes	yes	yes	no	no	yes
Titichon	yes	no	no	yes	no	no	yes
Algodonal	yes	yes	yes	yes	no	no	no
Estanzuela	no	no	yes	no	no	no	no
Tapescos	no	no	no	no	no	no	no
Rincon del Buey	no	no	no	yes	no	no	no
Ostuman	no	no	yes	no	no	no	no
Yaragua	no	no	yes	yes	no	no	no

Stela 19, which lies outside the PAC I and Harvard Project survey areas, was not visible to any residents living in the valley proper (Figure 8.13). The monument is situated in a small valley, about 5.5 kilometers west of the Principal Group. It is in the central plaza of a relatively small and isolated settlement, and bears only hieroglyphic text, and epigraphers believe that Ruler 12 erected it to celebrate a *katun*-ending (Baudez 1994; Morley 1920). The viewshed of Stela 19 shows that it had a small visual domain and it therefore appears that its ability to communicate information to a broad audience was quite limited. This, then, suggests that its location was not selected to serve as a mnemonic that communicated information to Copán's inhabitants on a daily basis.

Since the discovery of the valley stelae, scholars have sought to understand why Ruler 12 placed them at dispersed locations across the valley (e.g., W. Fash 1983a, 2001; Marcus 1976; Morley 1920; Proskouriakoff 1973;) rather than in the civic-ceremonial center as was common in other Maya cities. While many of these explanations focus on lines-of-sight between the stelae, the implications of which were discussed earlier in this chapter, several scholars posit that they served as territorial markers that helped to centralize power by delimiting Ruler 12's area of control (W. Fash 1983a, 2001; Marcus 1976; Spinden 1913). I contend that the more people who could see these stelae, the more effective Ruler 12's strategy. The visibility data indicate that by placing the stelae at relatively equidistant locations across the valley, with the exceptions of Stelae 13 and 19, the majority of Copán's residents were able to see at least one of the valley stelae from their homes. Exceptions were people living in sub-communities in the far western part of the valley. However, given that these stelae were erected in the mid-seventh century, prior to settlement in the far western part of the valley, the results support the hypothesis that Ruler 12 erected the stelae to target the largest number of valley inhabitants possible, most likely as part of a larger strategy to centralize power. Subsequent rulers maintained the stelae and their expansive visual domains, suggesting that their ability to send messages on a daily basis to a large portion of Copán's population continued to be an important strategy to display dynastic power and legitimacy.

Question 5: Did Copán's valley stelae address a larger percentage of elites or commoners?

This section examines whether the visual domains of Copán's valley stelae differentially targeted commoners or elites. Such information is critical because it can provide insight into sociopolitical relationships between the royal dynasty, who erected the monuments, and Copán's different social classes. If, for example, a larger percentage of elites than commoners could see the stelae, it suggests that (1) the elites intentionally located themselves in locales that allowed them to see the stelae and/or (2) the royal dynasty erected the stelae in places that targeted an elite audience.

Table 8.4: Visibility of valley stelae to commoners vs. elites

Stela	Visibility to Commoners	Visibility to Elites
Stela Petapilla	16.5%	36.6%
Stela 5	25.6%	26.8%
Stela 6	21.5%	22.0%
Stela 10	40.8%	65.8%
Stela 12	69.7%	87.8%

Table 8.4 shows the percentages of visibility to commoners versus elites for Stelae 5, 6, 10, 13, and Petapilla. It does not list percentages for Stelae 12 and 19 because they were visible to very few households in the Copán Valley. The table indicates that similar percentages of commoners and elites could see Stelae 5 and 6. However, there are marked differences in the percentages of commoners and elites who were able to see Stelae Petapilla, 10, and 12—approximately 20% more elites than commoners were able to see these three stelae.

Given that Ruler 12 erected these stelae over 100 years before Ruler 16 became king, and that Copán's population boomed between their reigns, it is impossible to know whether or not Ruler 12 intended to use the stelae to target the same social groups as were addressed during Ruler 16's reign in the late eighth and early ninth centuries. Regardless, we do know that Stelae Petapilla, 10, and 12 disproportionately targeted the elite at the end of the Late Classic, suggesting a greater connection between the elite classes and the functionality of these monuments. These findings lead to three interpretations that have implications for understanding sociopolitical relations at Copán: (1) the elite were charged with organizing ritual events that took place at these monuments; (2) the royal dynasty sent targeted messages to the elite about royal power and legitimacy via the valley stelae; and (3) the visual connections between the elite and the stelae reinforced social bonds and promoted social cohesion between the king and elites. If during the reigns of Rulers 14, 15, and 16, Copán's nonroyal elite were competing with the royal dynasty for power, as posited by Barbara Fash (B. Fash et al. 1992) and William Fash (2001), then ensuring the continuance of visual ties between the valley stelae and the elite, despite dramatic population growth, may reflect a specific sociopolitical strategy, one that is reminiscent of Ruler 12 and that sought to centralize power by reaching out to valley occupants, especially the elite.

Two Alternative Hypotheses for the Valley Stelae: Signposts or Procession Route?

While the previous sections on lines-of-sight and visual domains help to investigate earlier hypotheses about the functionality of Copán's valley stelae, we can glean even more information by integrating the visibility results with least-cost path data.

Figure 8.20 shows that the least-cost paths from Stela 19, located at the valley's western edge, and Stela 13, located at the valley's eastern edge, pass by four of the other five valley stelae en route to the Principal Group. Stela 13's least-cost path passes within 40 meters of Stela Petapilla, and Stela 19's least cost-path passes within 130 meters of Stela 10. Moreover, the least-cost path from Stela 19 also passes within 260 meters of Stelae 5 and 6. As for the visibility data, they indicate that lines-of-sight exist between Stela Petapilla and the Principal Group, the Principal Group and Stelae 5 and 6, and Stela 6 and Stela 10.

The lines-of-sight linking the valley stelae along a common least-cost path lead me to propose two alternative hypotheses for the placement of Copán's valley stelae. On the one hand, these routes may indicate that the stelae served as signposts guiding foreign visitors and recounting Copán's glory and power to them as they entered the city. On the other hand, given that the contemporary Maya as well as the ancient Maya incorporated pilgrimages, or ritual circuits, into many of their ceremonies (Baudez 1991; Hanks 1990; Newsome 2001; Orr 2001), these stelae may have been part of a procession route that stopped at six of the seven valley stelae. These two hypotheses are not mutually exclusive, nor do they discredit some of the earlier interpretations about the functionality of the valley stelae.

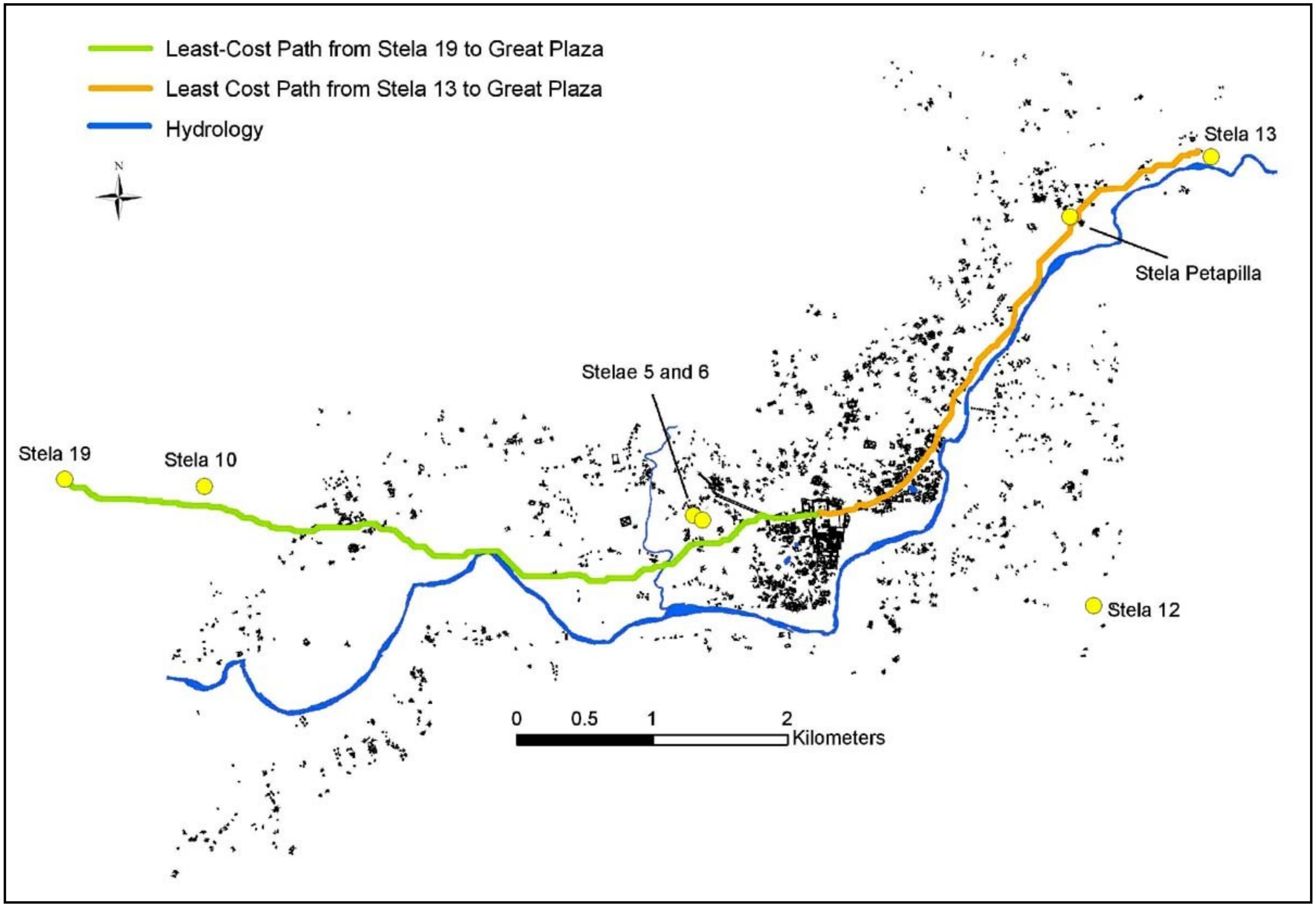


Figure 8.20: **Least-Cost paths to Great Plaza from Stelae 19 and 13**

Summary and Conclusions

In this chapter, I analyzed the visual domains for seven large civic-ceremonial monuments and Copán's seven valley stelae. I employed directionality to: (1) investigate whether expansive views correspond to cardinality or replicate the quadripartite pattern seen in other aspects of ancient Maya site planning, (2) test three hypotheses explaining the function of the valley stelae, and (3) determine whether the visual domains of the valley stelae targeted particular locales or specific social groups.

The visibility data presented in this chapter do *not* indicate that Copán's inhabitants organized the built environment, whether Principal Group buildings or individual households, to allow for views in specific directions that replicated, in some way, the notion of cardinality. In other words, there was no obvious pattern pointing to a quadripartite division of visual domains in the city. This is not to say, however, that there were not visual connections between particular locales and specific buildings, architectural complexes, and stelae that help to elucidate sociopolitical relationships and new facets of sociopolitical organization. One of the most interesting findings was that the valley stelae probably served multiple functions, ranging from sending targeted messages to the elite to channeling foreigners into the city along a specific route to guiding ritual processions through the valley. The next chapter examines the visual domains of dominant households to determine if, like the stelae, the occupants of these sites targeted specific locales or social groups.

Chapter 9:

Directionality of Dominant Households

In this chapter I employ the concept of visual domain, or field-of-view, to investigate whether the city's inhabitants constructed "dominant" buildings in locations that allowed for more expansive views in specific directions. (The reference to 'dominant' relates to Richard Leventhal's [1979] and Willam Fash's [1983a] identification of large architectural complexes that appear to dominate a sub-community, or *sian otot*—see discussion in Chapter 2). In sub-communities where paired dominant households exist, I measure intra-community visibility to determine if the sites are targeting different audiences, and examine Leventhal (1979) and Fash's (1983a, 1983b) hypothesis that paired sites reflect two dominant households that were occupied by lineage heads of competing and collaborating extended families. Additionally, I examine the visual domains of the four cornerstone sites that Maca (2002) posits as delineating the boundary of the city's urban core in order to identify patterns that may help to support or refute his argument.

The analysis is focused on dominant households for two reasons. First, in most cases these households are type 3 and 4 sites, which the access and visibility data indicate were often more accessible and more visible than others, and thus I wanted to investigate whether the visual domains of these sites exhibited any sort of directionality patterns, for instance, visual connectedness to the Principal Group or specific cardinal directions. Second, the access and visibility data suggest that in many cases the people living at type 2 and 3 sites experienced similar degrees of social connectivity. Oddly, several households, considered dominant by Leventhal and W. Fash, are designated as type 2 sites, and I therefore wanted to determine if visual similarities existed between the type 3 and 4 dominant households and the type 2 dominant households.

The directionality maps helped to identify *who* these dominant households may have been targeting with their visual messages. The maps also measured visual overlap among Copán's *sian otots*, serving as a line of evidence to help to begin to evaluate the validity of these sub-communities' proposed boundaries. The directionality maps provide information on both the near- and mid-distance visual domains (see Chapter 5 for discussion of methods). The results of the near-distance domain (0-282 meters) provided information on intra-community visibility patterns believed to be indicative of cultural groupings and communication flow. The mid-distance (283-5170 meters) results offered data on inter-community cultural groupings and communication flow.

The data are organized by physiographic zone to facilitate the discussion. The final results suggest that (1) intra-community visibility differences reflected distinct social spheres and/or functional differences between dominant households located within the same sub-community, and (2) a subset of dominant households served as seats of power that aggregated people from several sub-communities into a larger community, highlighting the presence of intermediate-level interaction spheres in the valley.

Zone 2—Low River Terrace in Center of Valley

Las Sepulturas

Unlike many other Copaneco sub-communities, Las Sepulturas contains several type 3 and type 4 sites. However, one of these sites, Group 9N-8, stands out because of its large size, complexity, ornate sculpture, and history of intensive excavation, and its possible function as a cornerstone site marking the eastern boundary of the urban core (Baudez 1989; W. Fash 1989; Maca 2002; Webster 1989). Group 9N-8 comprises 11 courtyard groups (Patios A-K) and several large and elaborate buildings (Figure 9.1) (Hendon 1987). While this group may not be the dominant household in Las Sepulturas, archaeological evidence suggests that its residents played a distinct and central role in the city's sociopolitical and economic life. In fact, hieroglyphs inscribed into the steps and bench of one of the group's most impressive structures, 9N-82, reference strong affiliations with Ruler 12, Ruler 13, and Ruler 16 (W. Fash 2001).

The near- and mid-distance visual domains of Group 9N-8 indicate that its visual prominence may have been multi-functional. The mid-distance directionality map shows that the group's most prominent views were to the north and northeast, allowing Group 9N-8 residents to see visitors entering the valley from the northeast (Figure 9.2). Furthermore, as visitors traversed the valley from the east, presumably walking towards the city center, they would have been greeted by impressive and elaborate architecture, including Copán's major civic-ceremonial architecture and the homes of some of the city's wealthiest residents, one of which was Group 9N-8. The near-distance directionality map illustrates that nearly all Las Sepulturas residents were able to see Group 9N-8 from their homes (Figure 9.3). Such high visibility would have proclaimed messages of power, wealth, and prestige to any Copanecos living nearby or walking along the eastern *sacbe* as well as to foreigners entering the city.

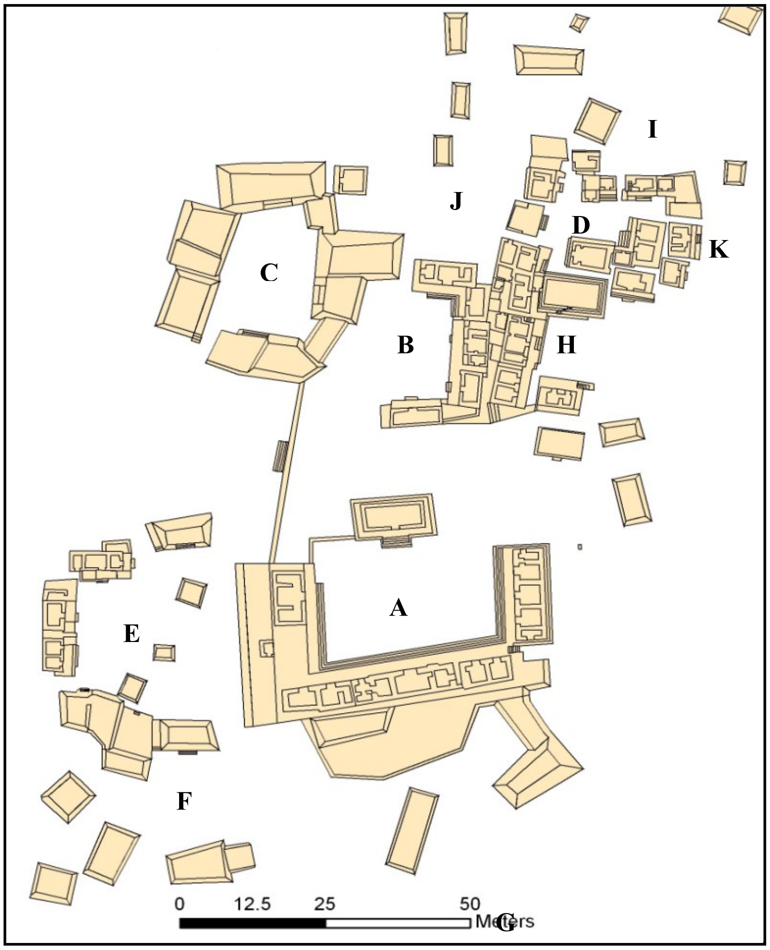


Figure 9.1: **GIS map of patios in Group 9N-8 in Las Sepulturas (based on Hendon 1987)**

A comparison of mid-distance directionality maps for two other Las Sepulturas type 4 sites, Groups 8N-11 and 9M-19 (Figures 9.4 and 9.5), to Group 9N-8 (Figure 9.2) indicates that the three sites have overlapping mid-distance visual domains. In contrast, a comparison of the Group 9N-8's near-distance map (Figure 9.3) to the near-distance maps of Groups 8N-11 and 9M-19 (Figures 9.6 and Figure 9.7) show that Group 9N-8 addresses the largest number of local residents. These results suggest that the occupants of Group 9N-8 had access to resources such as labor, materials, and a prominent location (perhaps due to longevity) that enabled them to visually target a larger audience than some of their elite neighbors.

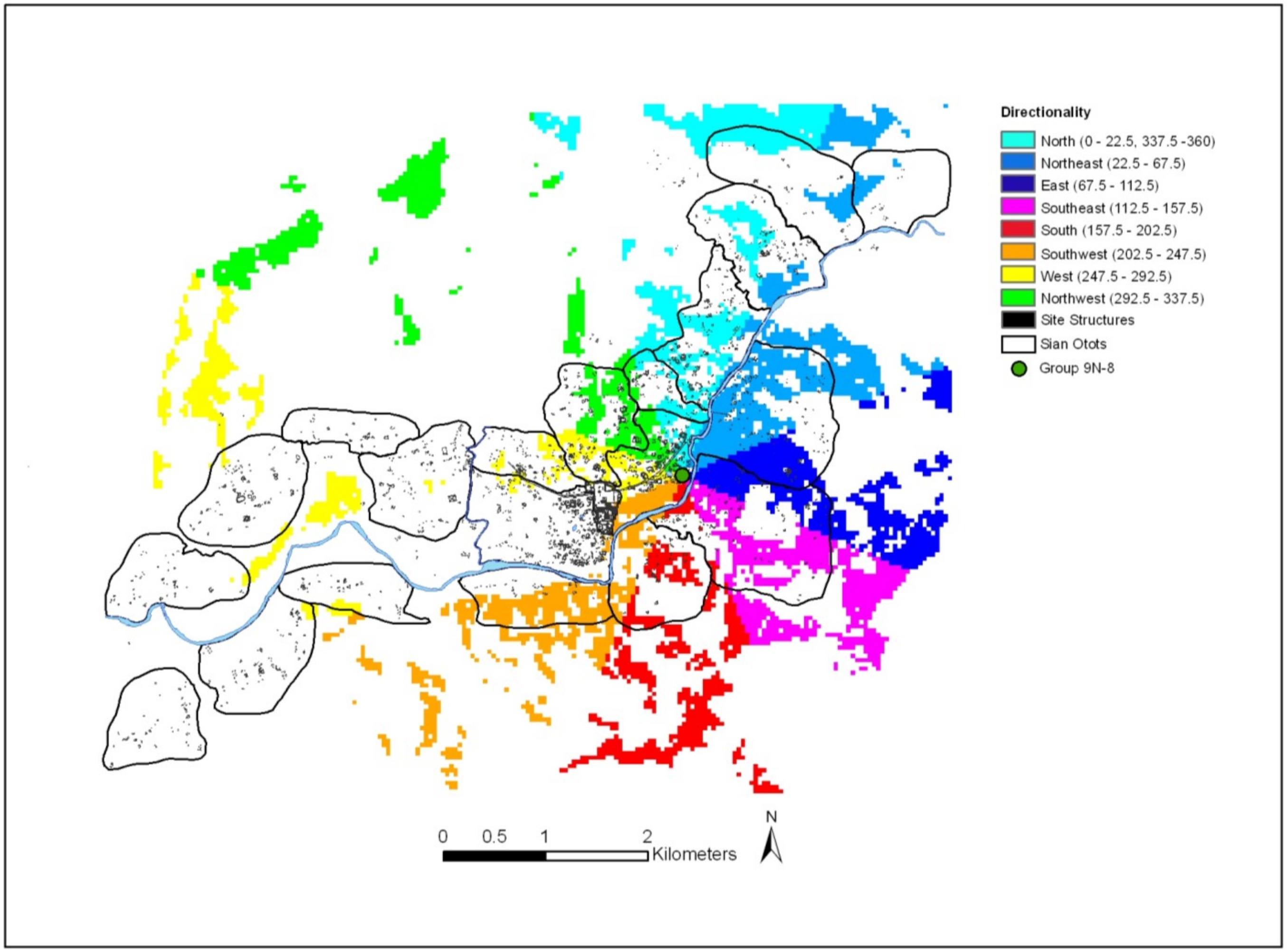


Figure 9.2: **Directionality map for Group 9N-8 in Las Sepulturas, Copán**

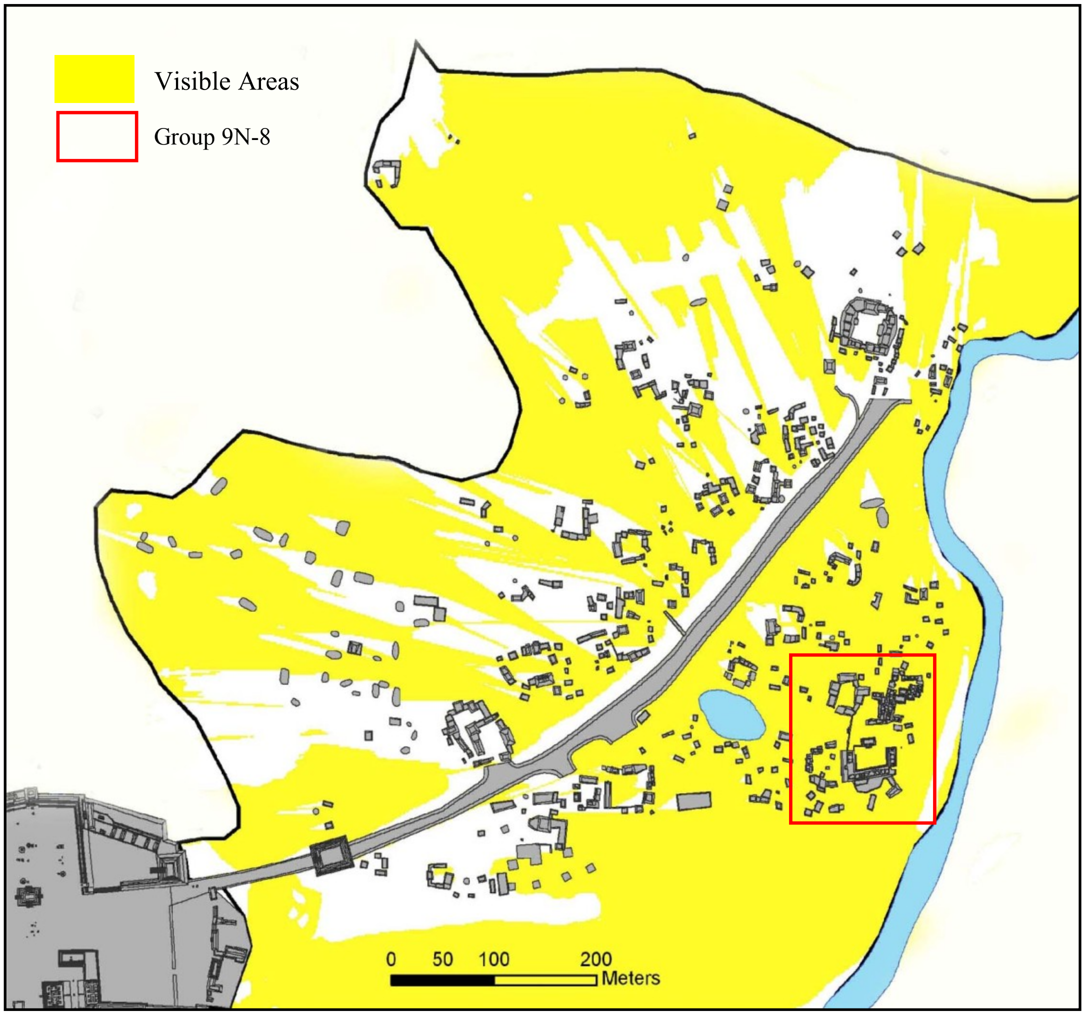


Figure 9.3: **Intra-community visibility of Group 9N-8 in Las Sepulturas**

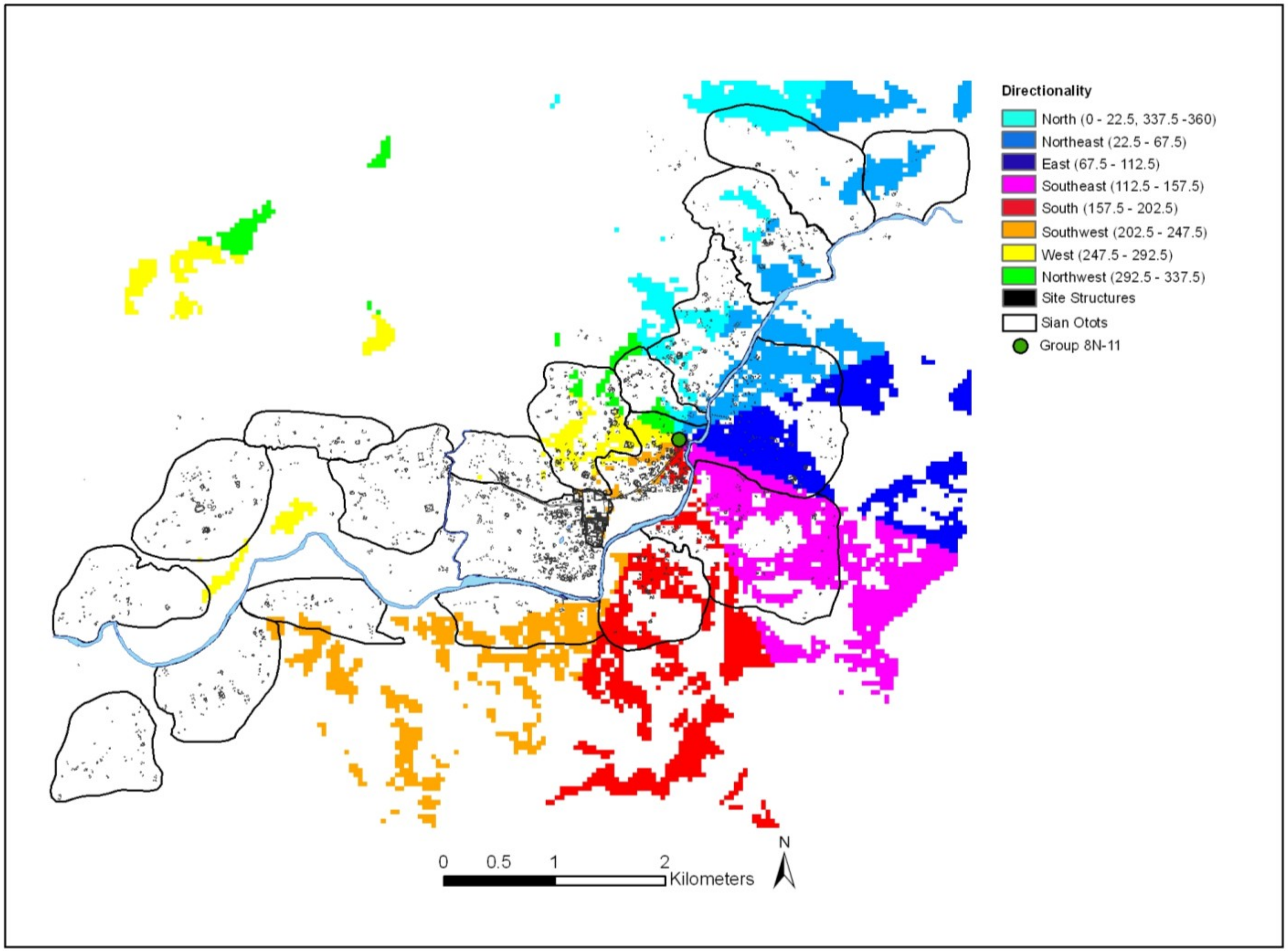


Figure 9.4: **Directionality map for Group 8N-11 in Las Sepulturas, Copán**

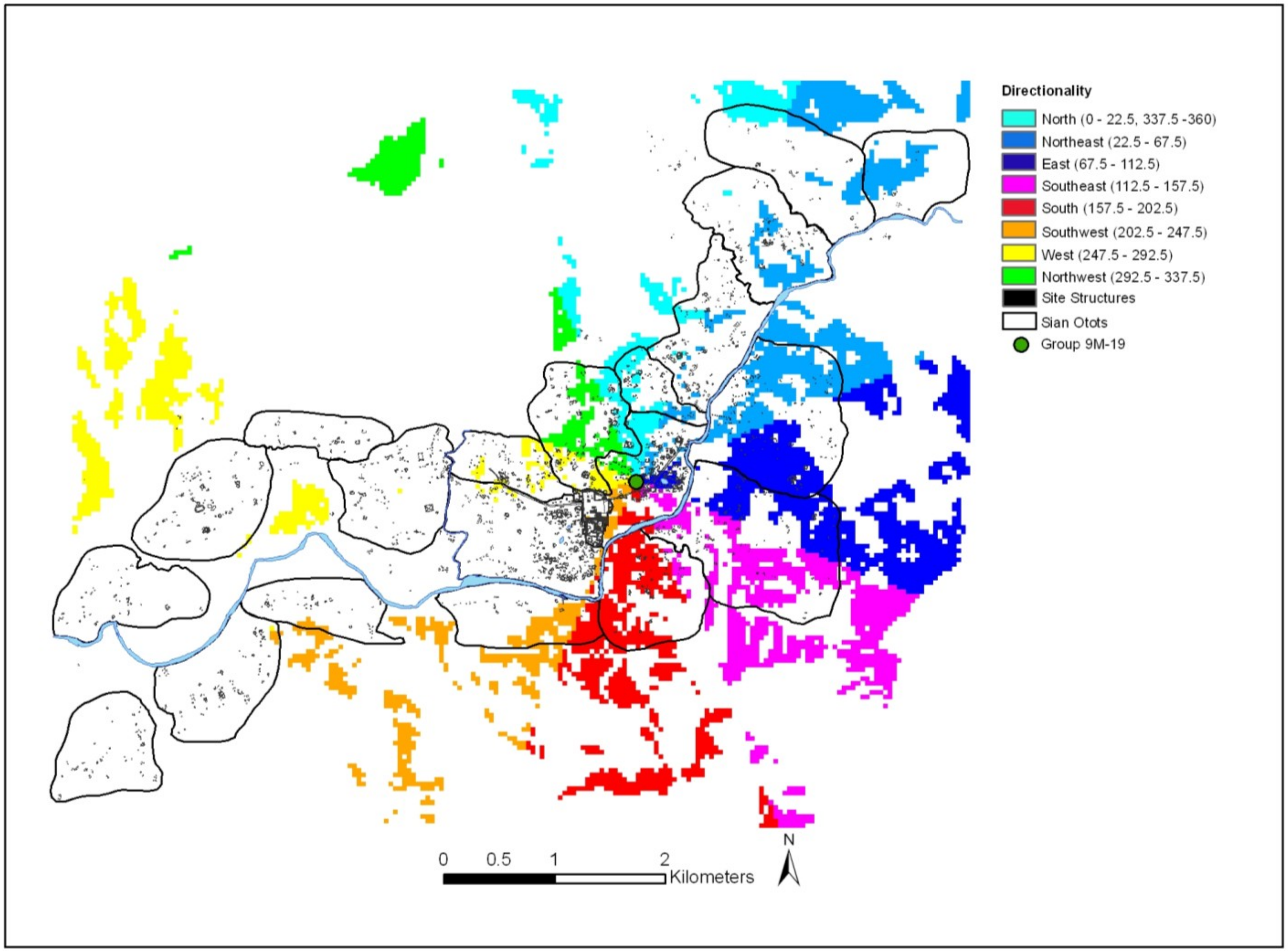


Figure 9.5: **Directionality map for Group 9M-19 in Las Sepulturas, Copán**

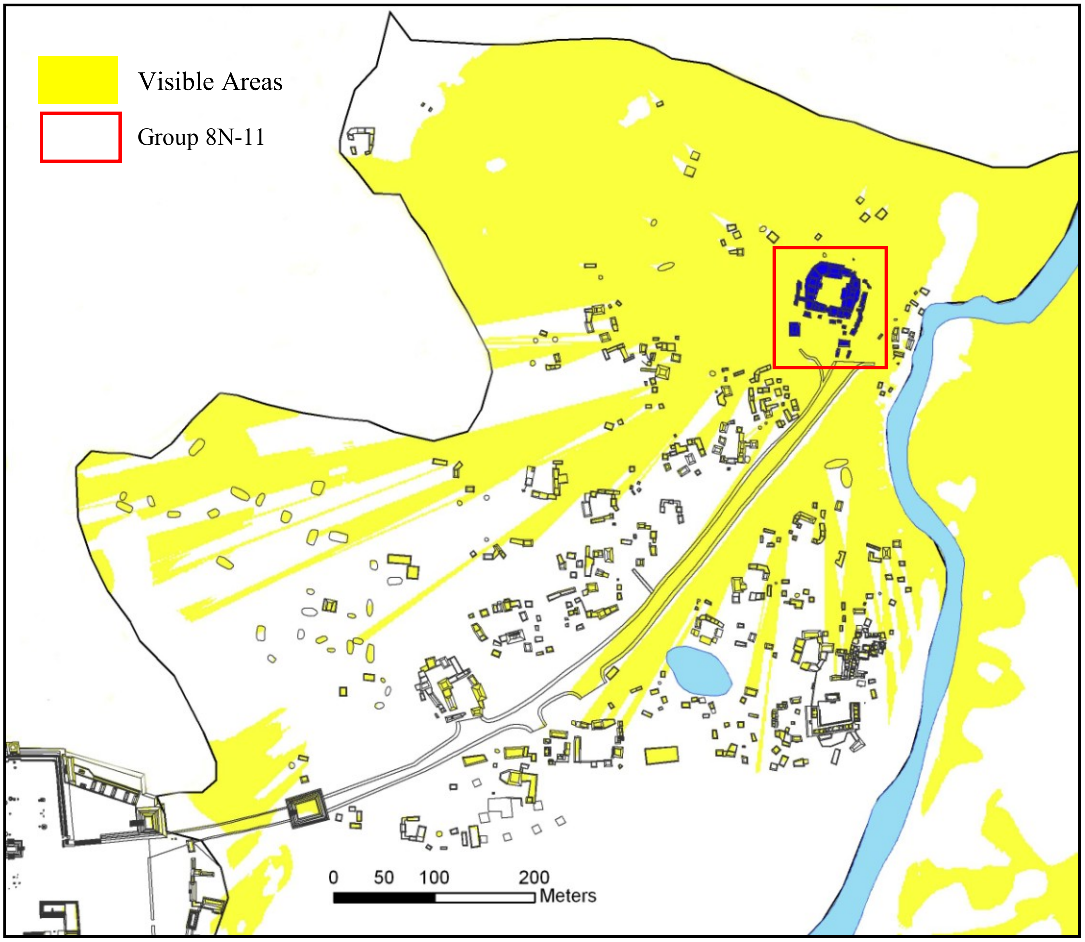


Figure 9.6: **Intra-community visibility of Group 8N-11 in Las Sepulturas**

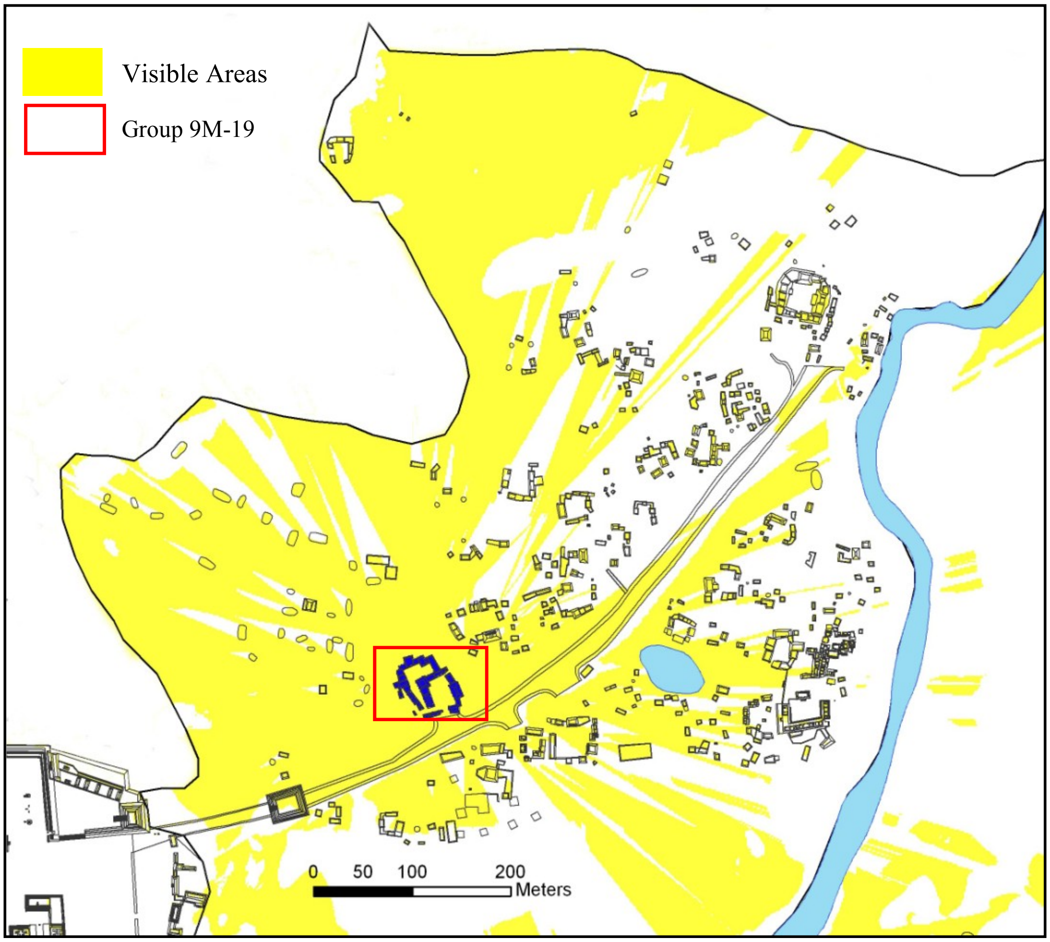


Figure 9.7: **Intra-community visibility of Group 9M-19 in Las Sepulturas**

El Bosque

Like Las Sepulturas, its western counterpart the sub-community of El Bosque, may have several dominant households. It contains several type 3 and type 4 sites; I chose to analyze three sites, Groups 11K-6 (type 4), 10L-18 (type 4), and 11L-13 (type 3) for two reasons: (1) to determine whether the residents of type 3 and type 4 sites in different areas of El Bosque were addressing different groups of people (Figure 9.8), and (2) to compare the visual domain of Group 11K-6, hypothesized to mark the southern boundary of the urban core, to the city's other cornerstone sites (Maca 2002).

The directionality maps for Groups 11K-6, 10L-18, and 11L-13 show that the groups had similar mid- and near-distance visual domains (Figures 9.9-9.11). All three groups targeted sites located in the west-central part of the valley. The visual domain of Group 11K-6, the city's southern cornerstone site, does not show much overlap with its eastern counterpart, Group 9N-8, in Las Sepulturas. Instead, Group 11K-6's visual domain (Figure 9.9) targeted residents living in the western part of the urban core, while Group 9N-8's visual domain addressed people living in the east (Figure 9.2); and thus, the two visual domains complement one another.

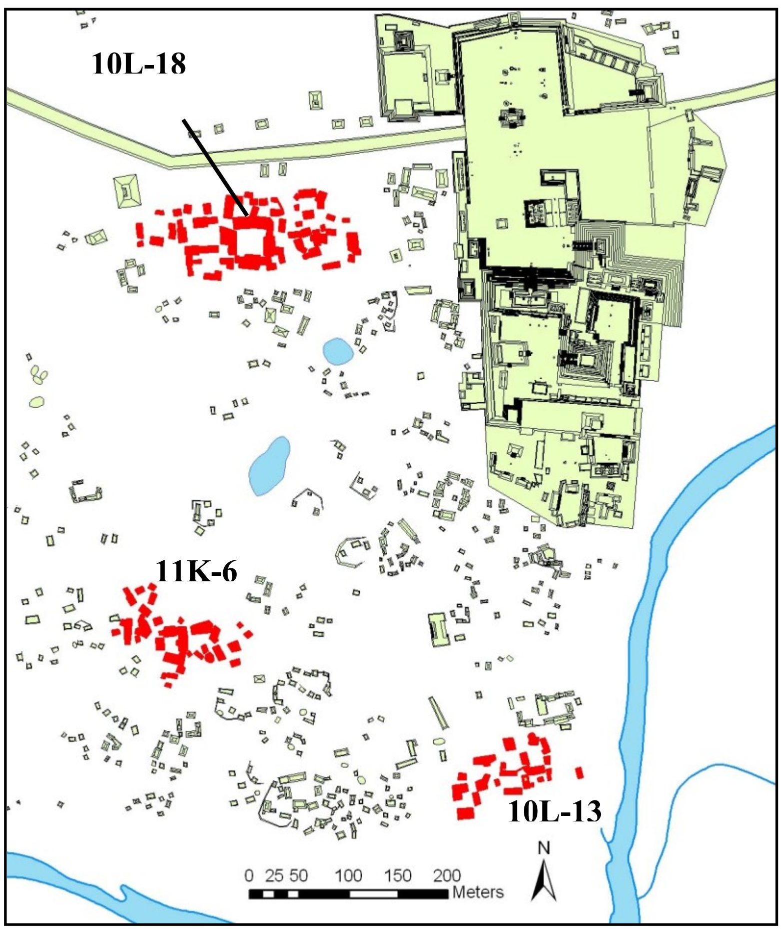


Figure 9.8: **Map of El Bosque highlighting sites used in directionality analysis**

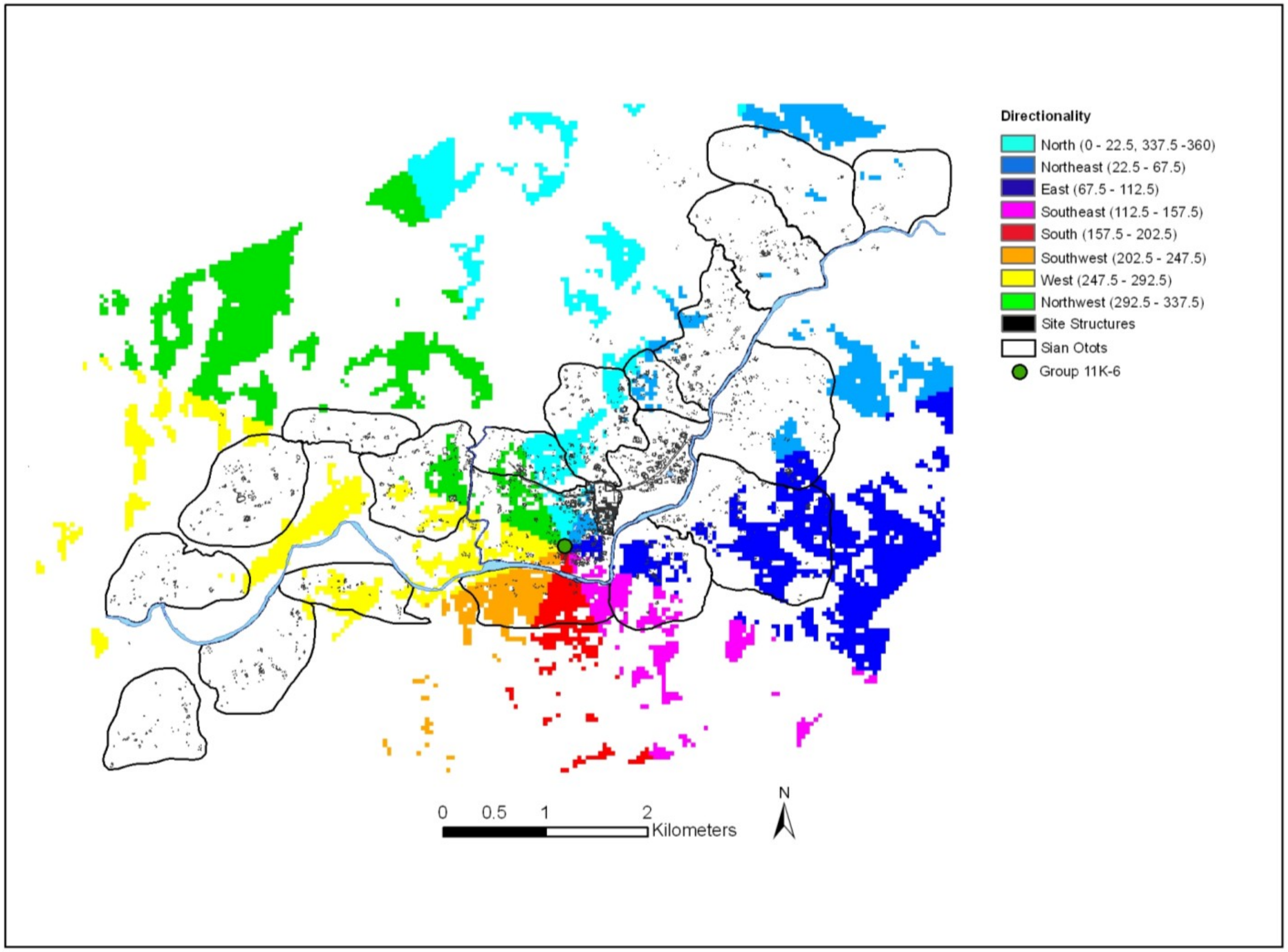


Figure 9.9: **Directionality map for Group 11K-6 in El Bosque, Copán**

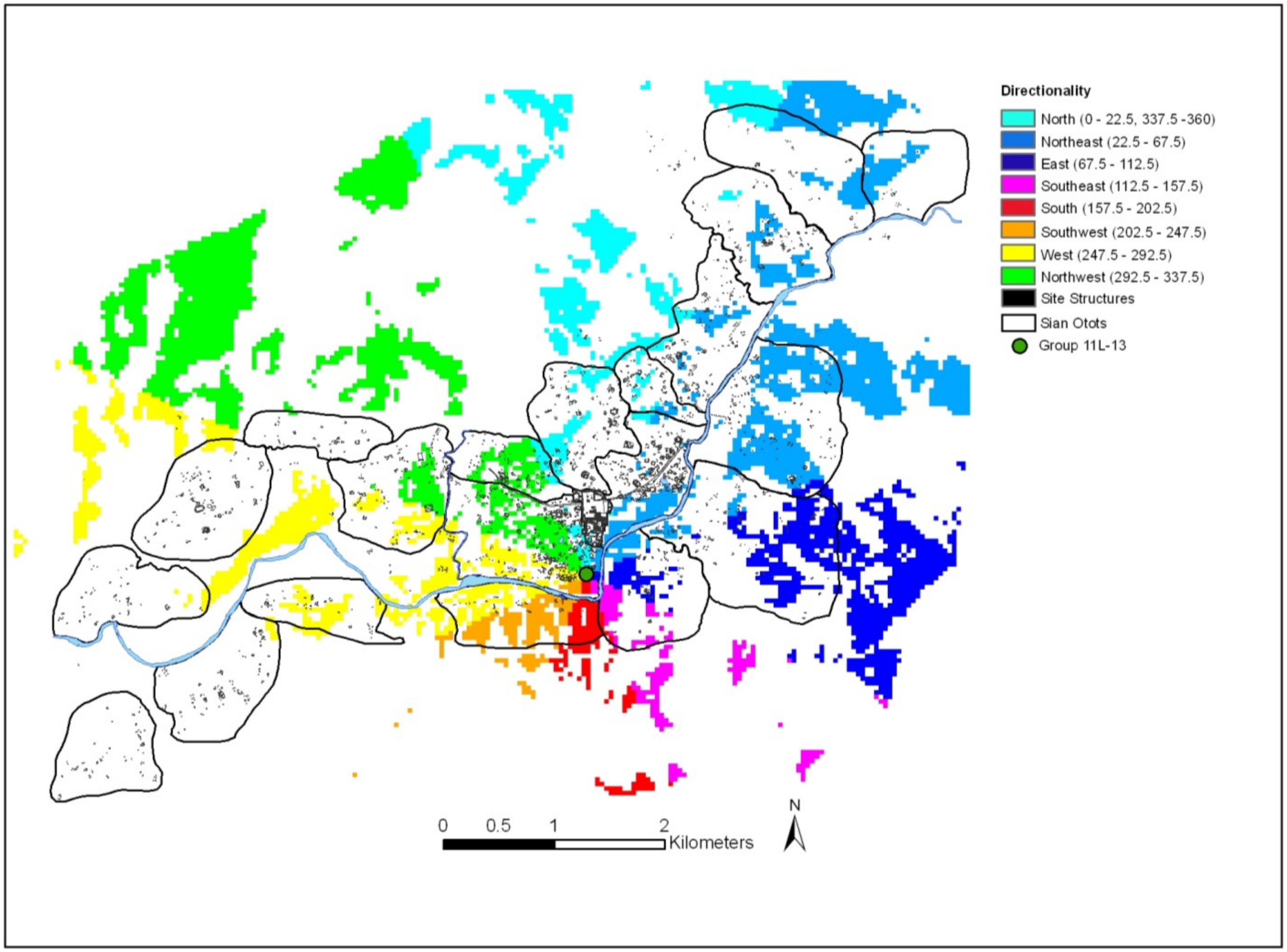


Figure 9.10: **Directionality map for Group 11L-13 in El Bosque, Copán**

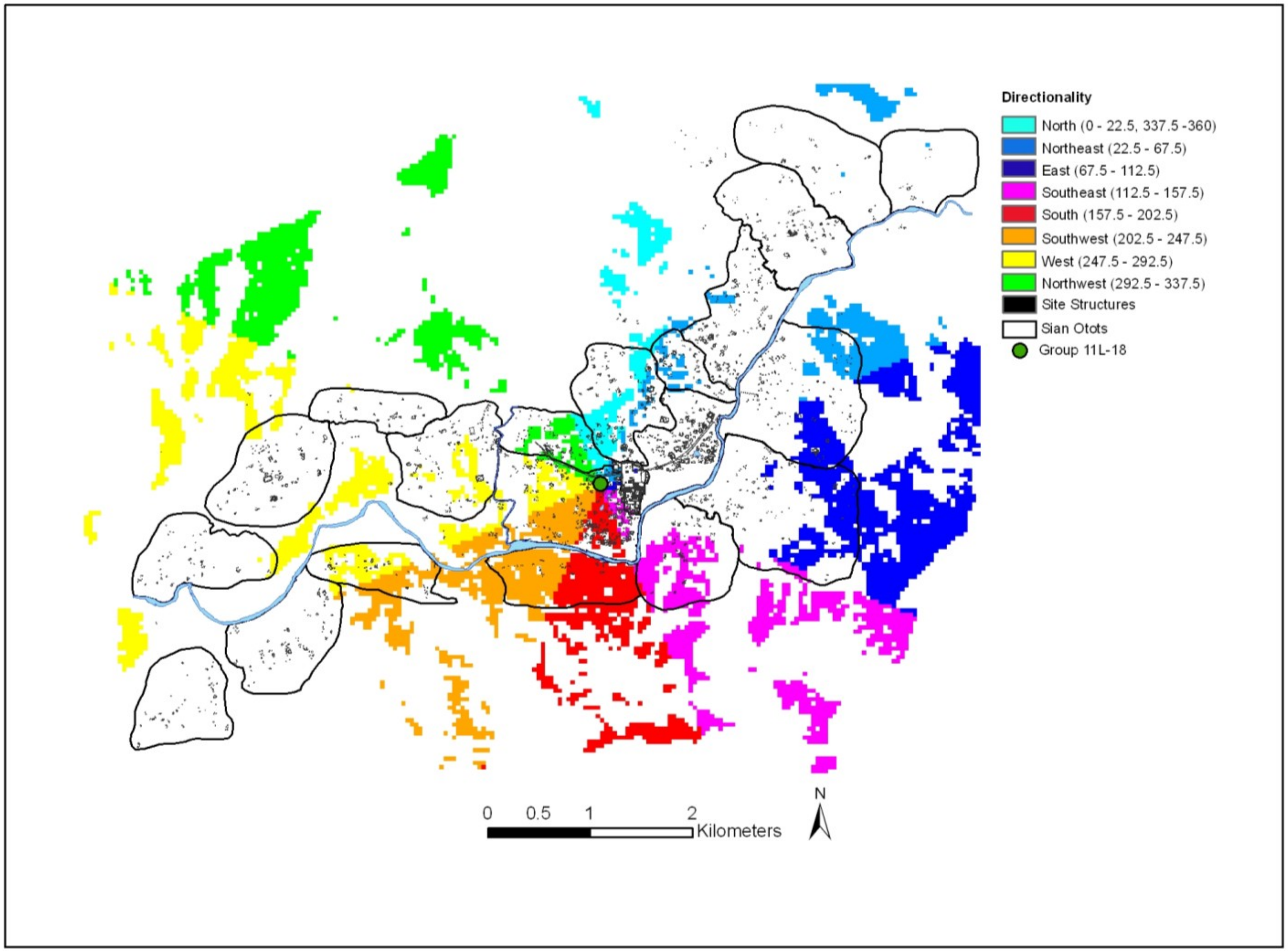


Figure 9.11: **Directionality map for Group 10L-18 in El Bosque, Copán**

Zone 3—Foothills North of River

Comedero

The sub-community of Comedero contains one type 4 site, Group 9J-5, and no type 3 sites. Group 9J-5 appears to have been not only a dominant household within the valley, but also a cornerstone site marking the western boundary of Copán's urban core (Maca 2002). The directionality map in Figure 9.12 shows that Group 9J-5 had expansive views of the Principal Group, El Bosque to the south, Algodonal to the southwest, and Zone 4 sites to the southeast. Its visual domain overlaps with that of Group 9N-8, the city's eastern cornerstone site to the southeast and it overlaps with Group 11K-6, the city's western cornerstone site to the south. This pattern does not reflect the same visual complementarity seen for Groups 9N-8 and 11K-6. Moreover, while Group 9J-5 overlooked most of Comedero, it did not maintain visual contact with households situated in the western and northeastern parts of the sub-community perhaps, suggesting that these non-visible sites were not an integral part of the sub-community and consequently were not considered part of the urban core.

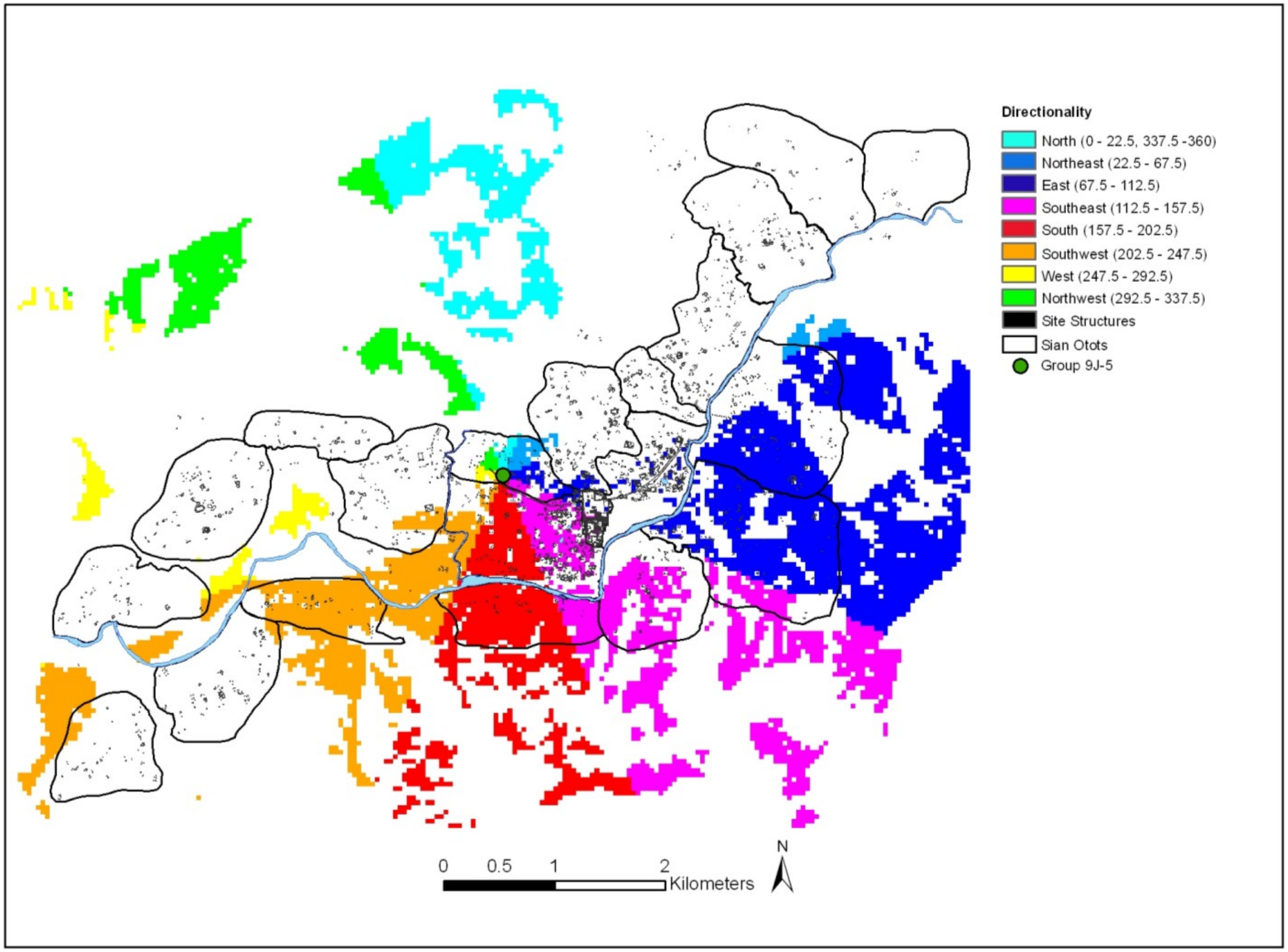


Figure 9.12: **Directionality map for Group 9J-5 in Comedero, Copán**

Chorro

The sub-community of Chorro contains one type 3 site, Group 7M-16. Using the Harvard Site Typology criteria, its size, complexity, and mound height make it the *sian otot's* only dominant household. However, Maca (2002) argues that the distinct U-shape of Group 7M-8, a type 2 site, makes it a cornerstone site marking the northern boundary of the urban core. Such a designation by the ancient Copanecos would have given the group a dominant status. Given these two possibilities, I analyzed both Group 7M-16 and Group 7M-8.

The directionality maps in Figures 9.13 and 9.14 illustrate that both of these groups had strong visual ties with sites in agricultural regions south of the Río Copán (Zone 4). In contrast, although these sites are part of Zone 3, their visual domains overlooked very few Zone 3 sites. Group 7M-16 actually has a larger visual domain than Group 7M-8 and some visual contact with the urban core, whereas Group 7M-8 can be seen only from one urban household (Group 9N-8 in Las Sepulturas). Moreover, all Chorro households other than Group 7M-8 and one small type 1 site (7M-4) were able to see Group 7M-16. In contrast, only the occupants of three type 1 sites in Chorro were able to see Group 7M-8. These differences suggest that the inhabitants of Group 7M-16 were most visually connected to other sub-community members, and it is thus more likely that they played a more integral role in local dynamics than the occupants of Group 7M-8. Given that Maca (2002) identifies Group 7M-8 as the city's northern cornerstone site (based on its U-shape), I expected that it would be highly visible to sub-community residents, and based on the complementary visual domains of Groups 9N-8 and 11K-6, the other two cornerstone sites examined thus far, I expected that its visual domain would focus to the northeast. However, neither expectation is met, suggesting that, using visibility as a criterion, perhaps Group 7M-8 is not a cornerstone site marking the northeast boundary of the city's urban core.

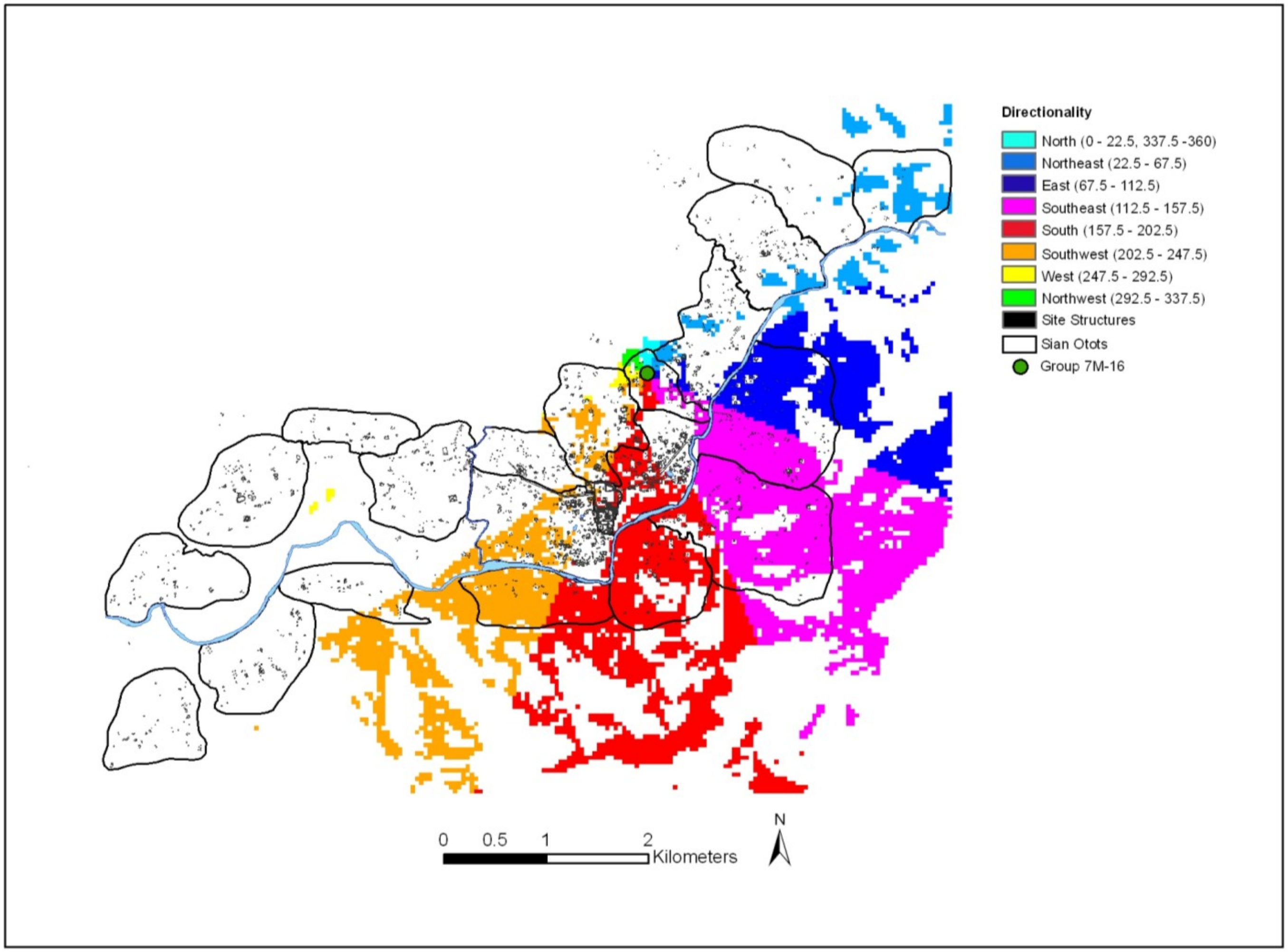


Figure 9.13: **Directionality map for Group 7M-16 in Chorro, Copán**

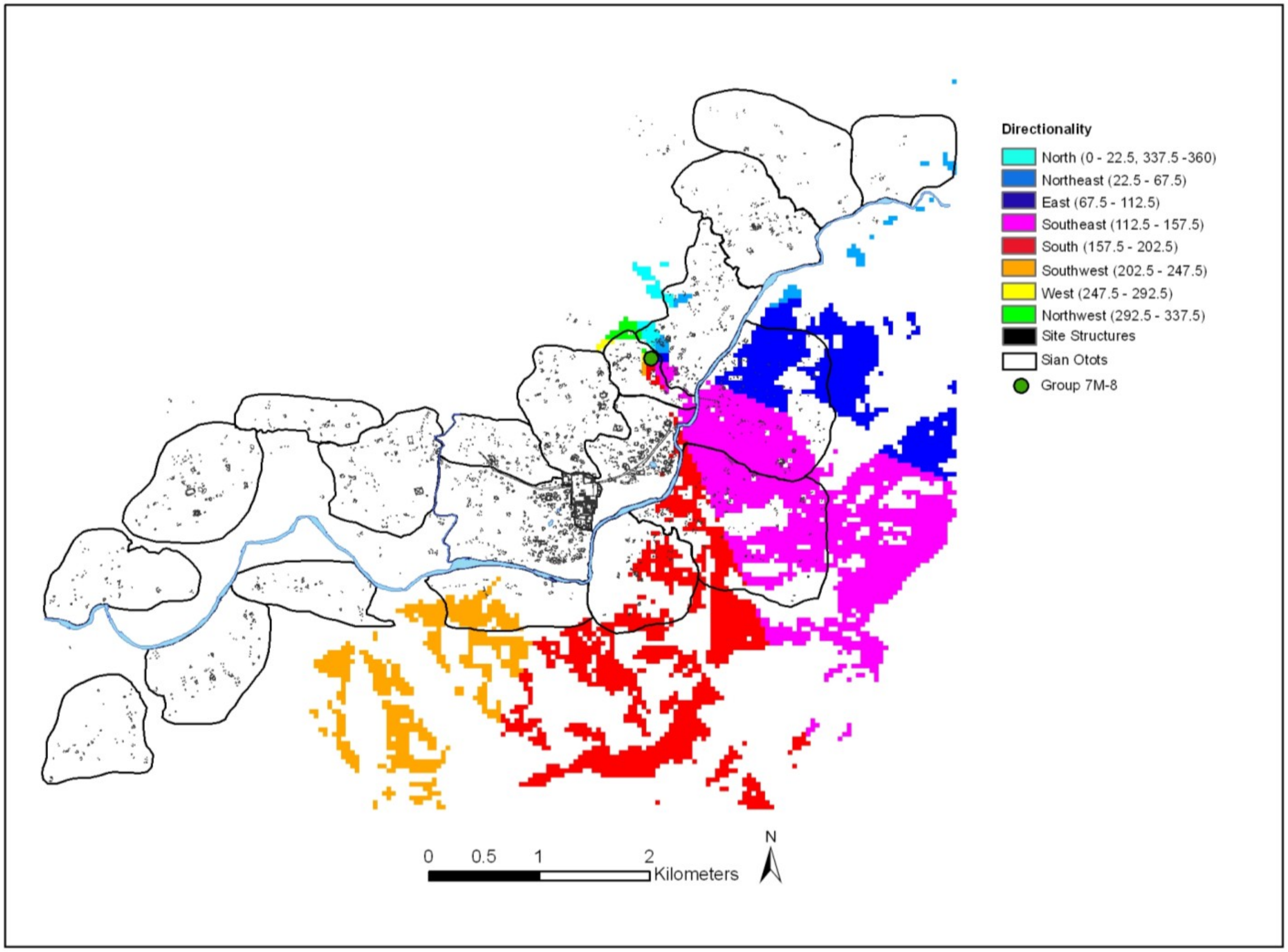


Figure 9.14: **Directionality map for Group 7M-8 in Chorro, Copán**

El Pueblo

The sub-community of El Pueblo contains two type 4 sites, Groups 9I-1 and 10I-1; however, because much of the area is now covered by the modern town of Copán Ruinas, it is impossible to say whether or not the area had several more dominant households during the late eighth and early ninth centuries. The directionality map of Group 9I-1, located in the northeastern part of the sub-community, indicates that very few El Pueblo residents could actually see the site (Figure 9.15). Instead, the site's visual domain formed a narrow north-south corridor toward the apparently unoccupied mountainous regions of the valley.

A comparison of the visual domain for Group 10I-1, the only other surviving elite site in the sub-community, to the visual domain of Group 9I-1 indicates that Group 10I-1 had a much larger visual domain (Figure 9.16). Group 10I-1 overlooked much of what is believed to have been agricultural land along the north side of the Río Copán, the Principal Group, and the steep southeastern hillside—all areas that were not visible to the residents of Group 9I-1. The presence of several Early Classic altars and a large pyramid-like structure at and in the vicinity of Group 10I-1 (see Figure 2.12) led archaeologists to believe that this area housed the city's ruling elite prior to relocation of the seat of power to the Principal Group in AD 426 by Yax K'uk' Mo, the dynasty's founder (W. Fash 1983a). Although Group 10I-1 has a larger visual domain than the sub-community's other elite site, it is still relatively small, suggesting that perhaps the area's low visibility was an impetus to relocate the city center (along with Yax K'uk' Mo's apparent desire to distinguish his reign from preceding valley rulers; (Sharer 2004).

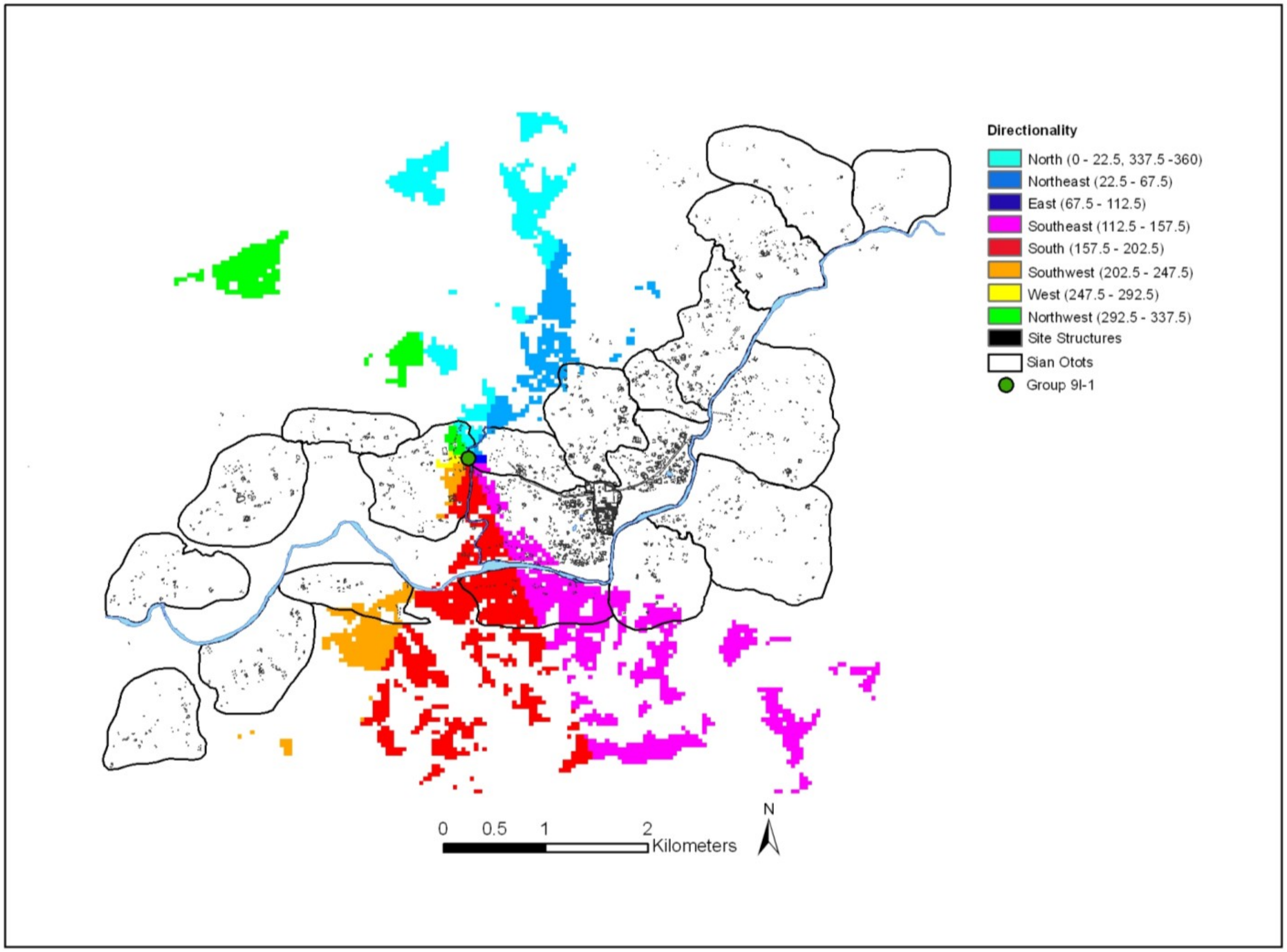


Figure 9.15: **Directionality map for Group 9I-1 in El Pueblo, Copán**

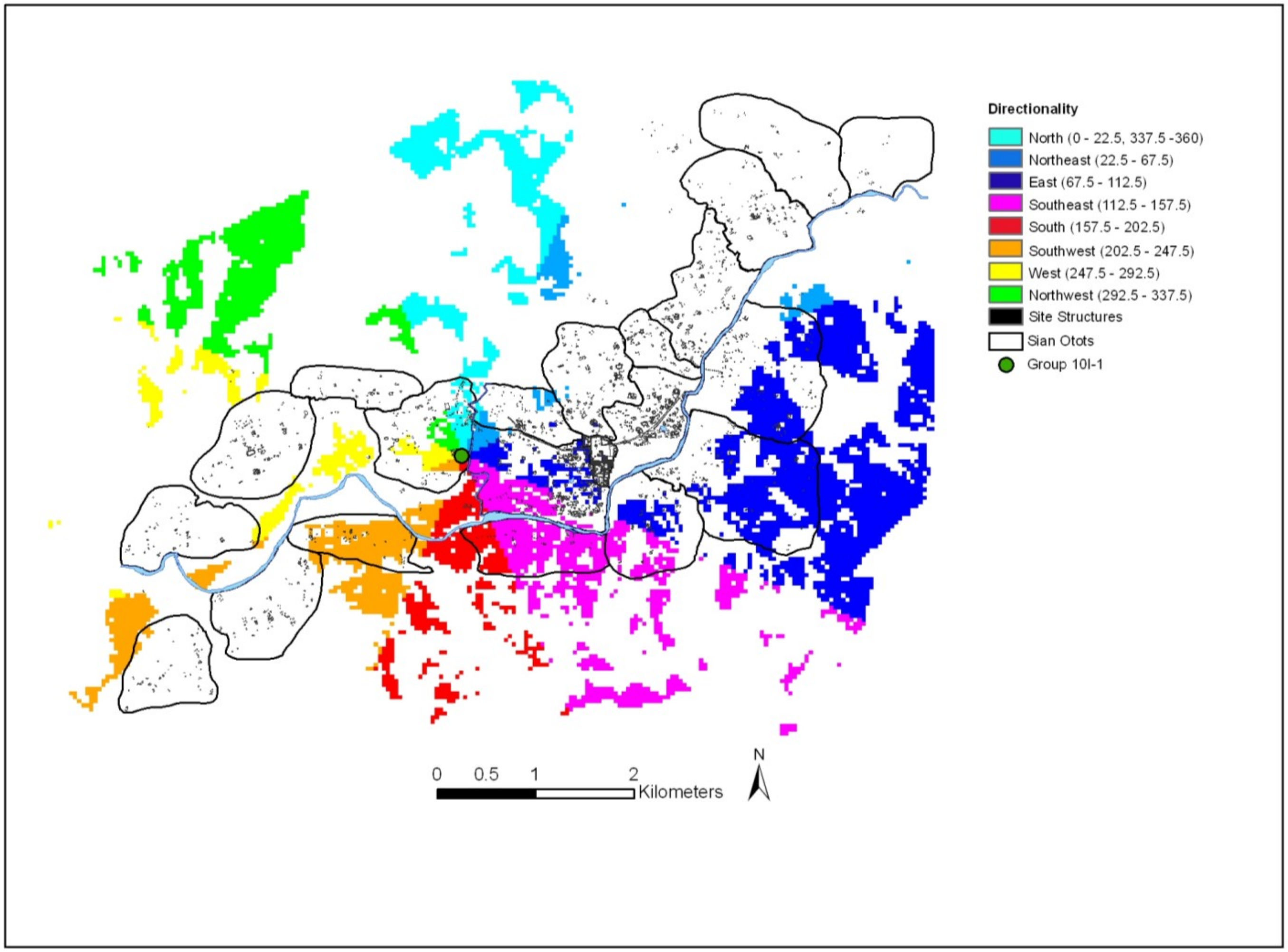


Figure 9.16: **Directionality map for Group 10I-1 in El Pueblo, Copán**

Salamar

The sub-community of Salamar contains four type 3 sites and three type 4 sites. There is currently no archaeological evidence to suggest that one of these sites was more dominant than the others. For the directionality analysis, I chose Groups 8L-10, 8L-12, and 9L-23 because archaeologists have excavated at these three sites. Excavation data from Group 8L-10 (type 3) and 8L-12 (type 4) reflect a duality in which the residents of these two sites played distinct roles in Copaneco society. Group 8L-10 was a relatively open, public site for hosting ritual events, while Group 8L-12, seemingly connected to 8L-10, was a private, enclosed space serving a strictly residential function (Ashmore 1991).

Recent excavations from Group 9L-23 (type 4), located less than 100 meters north of the Principal Group, may indicate that at least one of its residents was a member of the royal family (Nakamura, personal communication 2006). The multi-functional aspects of Salamar's type 3 and type 4 sites suggests that perhaps, at least in the urban core, dominant sites played different roles in society.

The directionality maps in Figures 9.17-9.19 show that all three of Salamar's type 4 sites had similar visual domains. The elite residents occupying these sites overlooked most other Salamar households, with the exception of those located in the northwestern part of the sub-community. Moreover, they had visual ties with Las Sepulturas residents and the occupants of many Zone 4 sites. Like the dominant household in Chorro, the three sites have very little visual connection with other Zone 3 sub-communities. These results suggest that all three groups were addressing residents living in the eastern half of the urban core and in the southeast part of the valley.

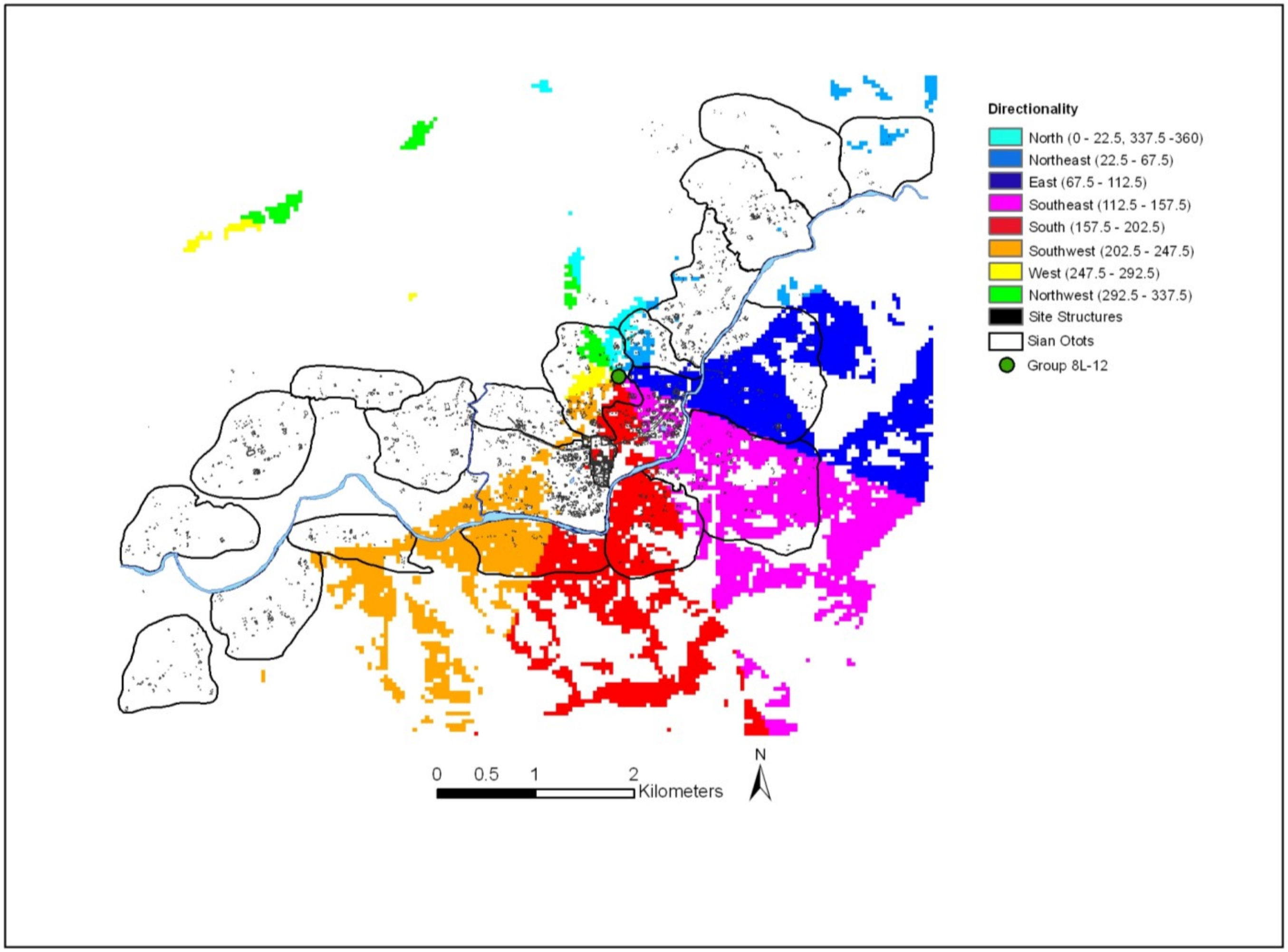


Figure 9.17: **Directionality map for Group 8L-12 in Salamar, Copán**

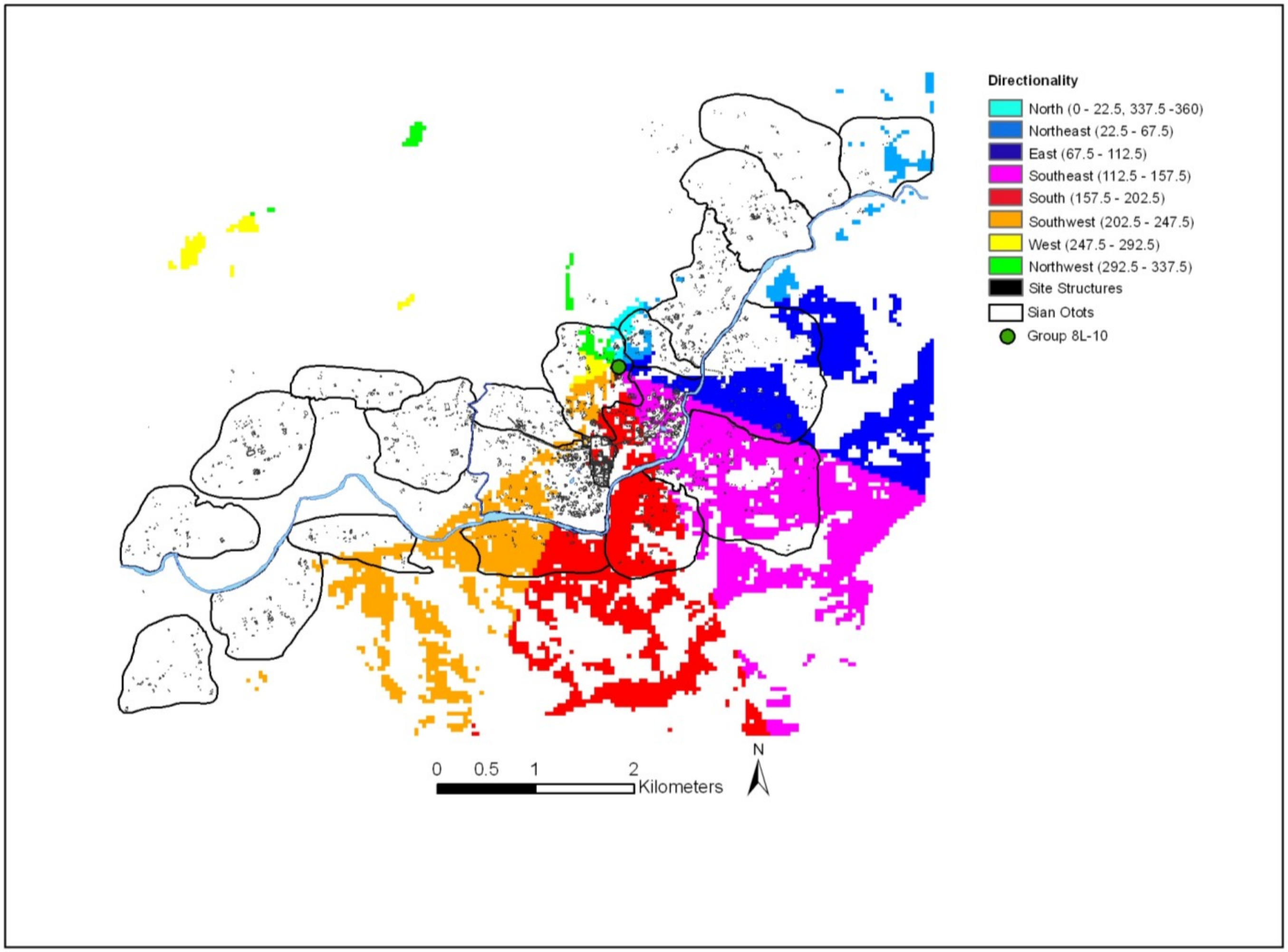


Figure 9.18: **Directionality map for Group 8L-10 in Salamar, Copán**

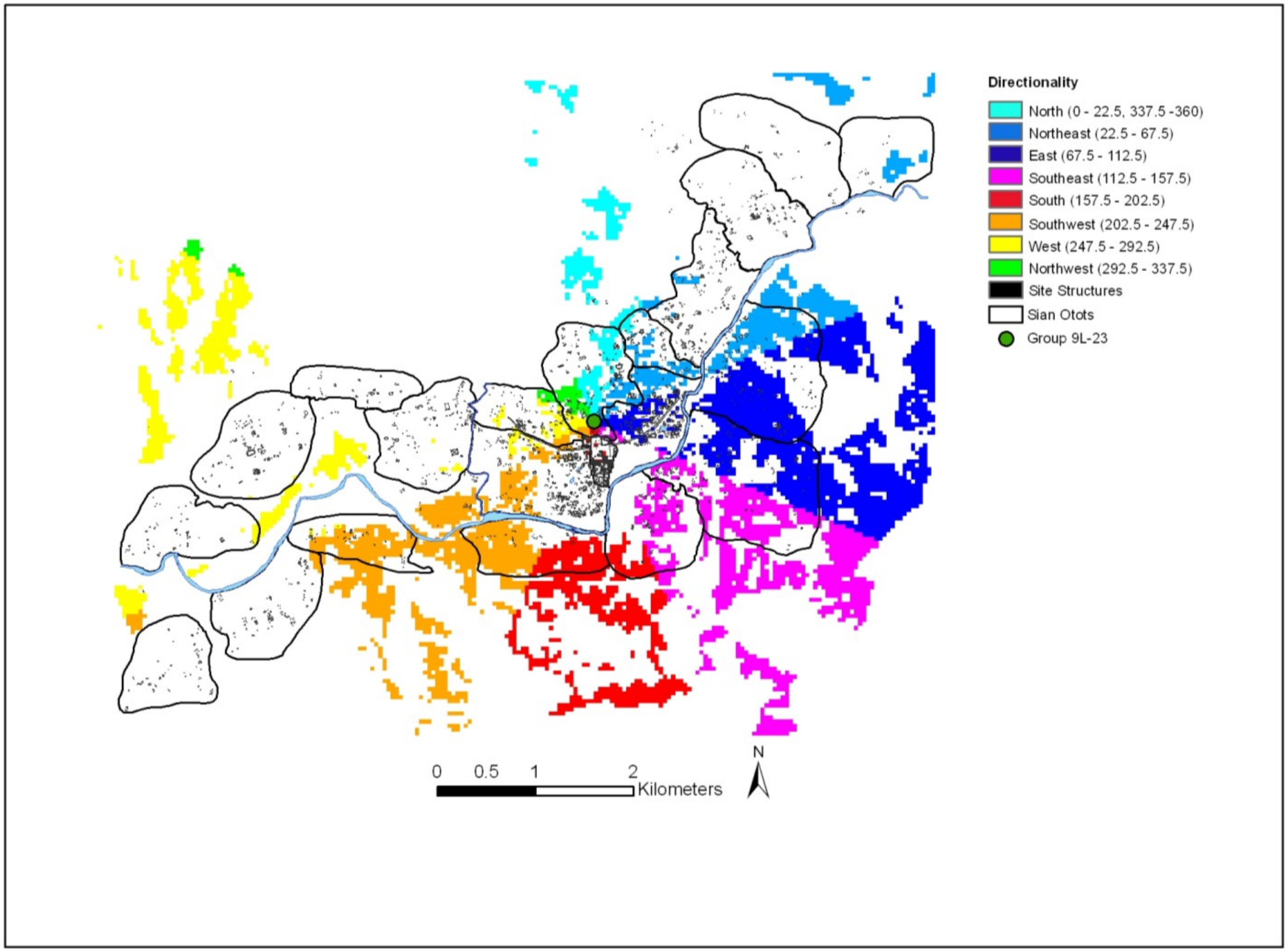


Figure 9.19: **Directionality map for Group 9L-23 in Salamar, Copán**

Rastrojon

Rastrojon contains one type 3 site, Group 7M-4, which is near the southern border of the sub-community. The directionality map in Figure 9.20 illustrates that many sites to the northeast were visible from this household. Its visual domain included only a few sites located along the Rastrojon-Chorro boundary, nine households in the east part of Las Sepulturas, and a larger number of Zone 4 sites south of the Río Copán. In general, Group 7M-4's visual domain was limited to the eastern part of the valley, with the exception of the El Puente sub-community in the southwest.

Although Rastrojon contains only one type 3 site, it contains seven type 2 sites, two of which may represent a paired residence. Such paired residences are found in several of Copán's hinterland *sian otots*. Archaeologists working at Copán believe that lineage heads of competing yet collaborating extended families occupied these paired residences (Leventhal 1981; W. Fash 1983a). Current interpretations do not comment on the possibility that paired hinterland residences may have functioned in a manner similar to Salamar's Group 8L-10 and Group 8L-12, that is, forming a public versus private dichotomy rather than serving as households for two lineages.

I compared the visual domains of Groups 6N-1 and 6N-2, identified as paired residences (W. Fash 1983a), to begin to explore the possibility that paired groups had distinct functions in society. Group 6N-1 and Group 6N-2 are approximately 50 meters apart and, like other paired residences, display marked differences. The southern site, Group 6N-2, has a formalized layout, and restricted access, and is relatively isolated from other sites. Group 6N-1, in contrast, has less formally arranged structures, and open access, and is not isolated. Additionally, Group 6N-1 does not appear to have a dominant structure, in contrast to Group 6N-2, which may have such a structure (Structure 6N-15) on its north side. Although both groups have similar mid-distance visual domains (Figures 9.21 and 9.22), they have very different near-distance domains. Figure 9.23 shows that Group 6N-1 addressed a relatively small group of people living in the northwestern part of Rastrojon. In contrast, Group 6N-2 had a larger visual domain that targeted a wider audience and established greater visual ties with nearby residences (Figure 9.24). If these paired sites represent two distinct lineages, I would expect both lineage groups to be surrounded by settlement and either to have similar visual domains or to visually target different groups (the members of their own lineages); instead, the results suggest differences in site layout, settlement density, and visibility. These differences in visibility may reflect social, functional, temporal, and/or ethnic differences. However, the site organization and visibility of additional paired sites need to be investigated before these possible explanations can be further examined.

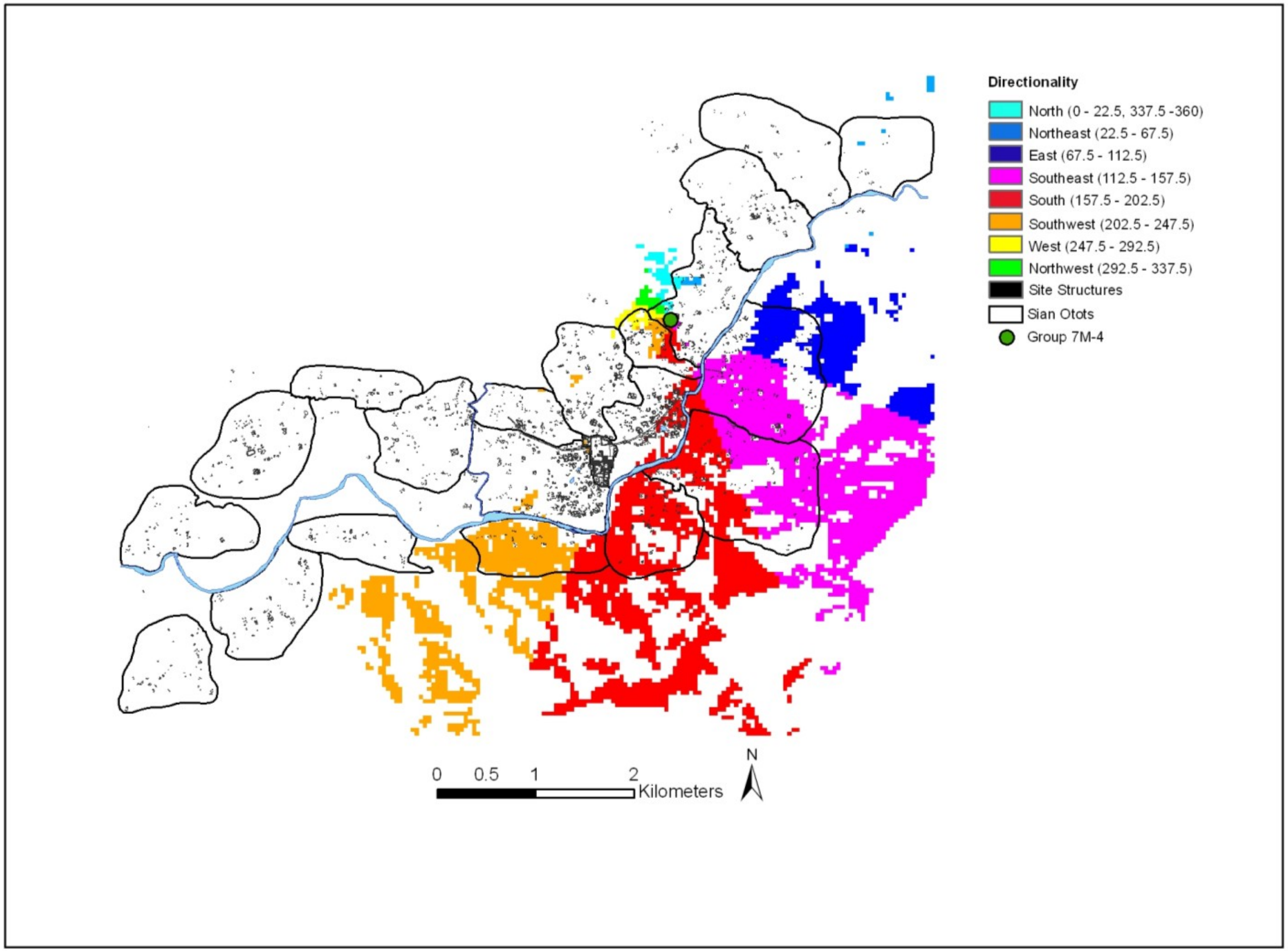


Figure 9.20: **Directionality map for Group 7M-4 in Rastrojon, Copán**

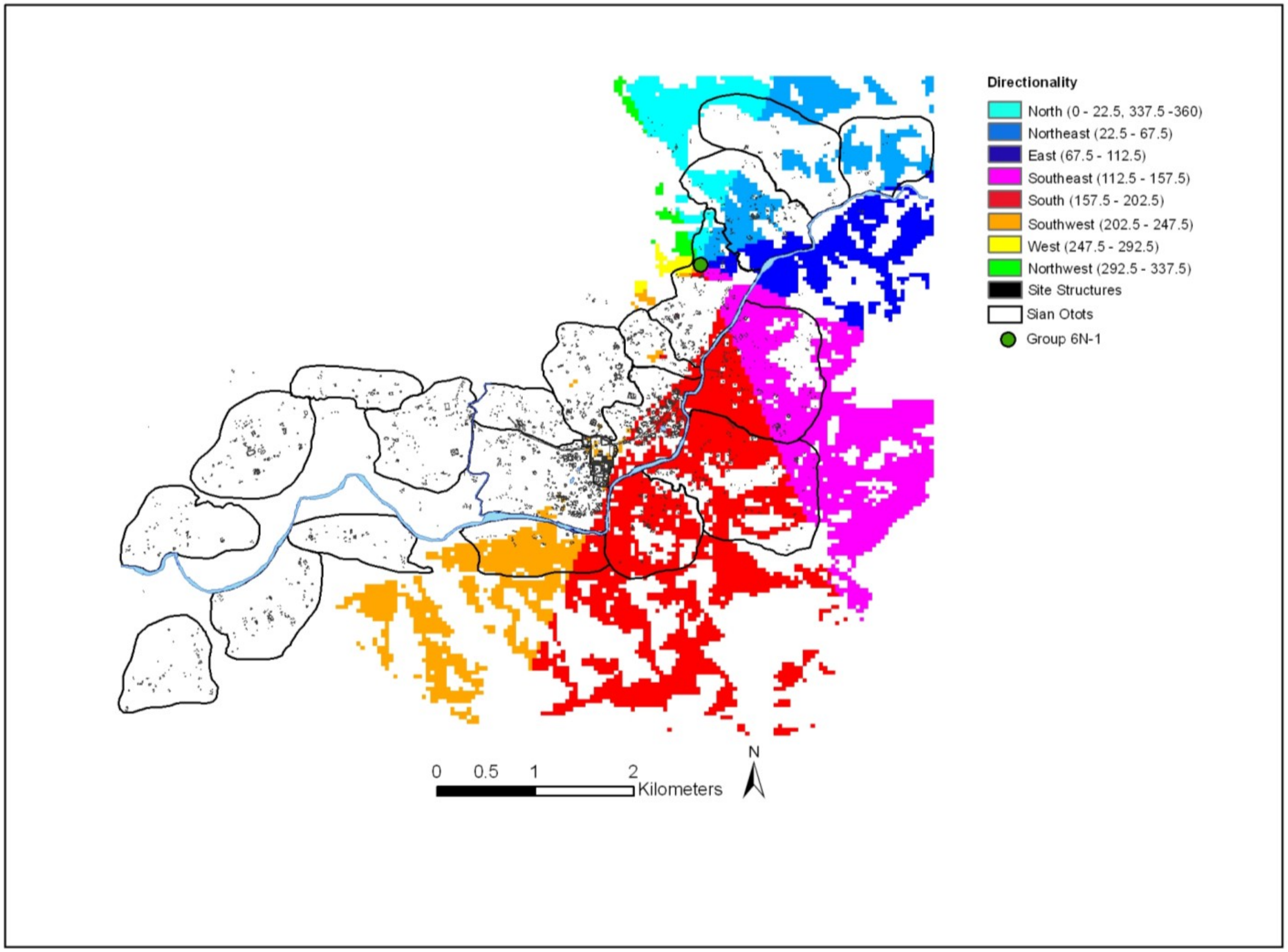


Figure 9.21: **Directionality map for Group 6N-1 in Rastrojon, Copán**

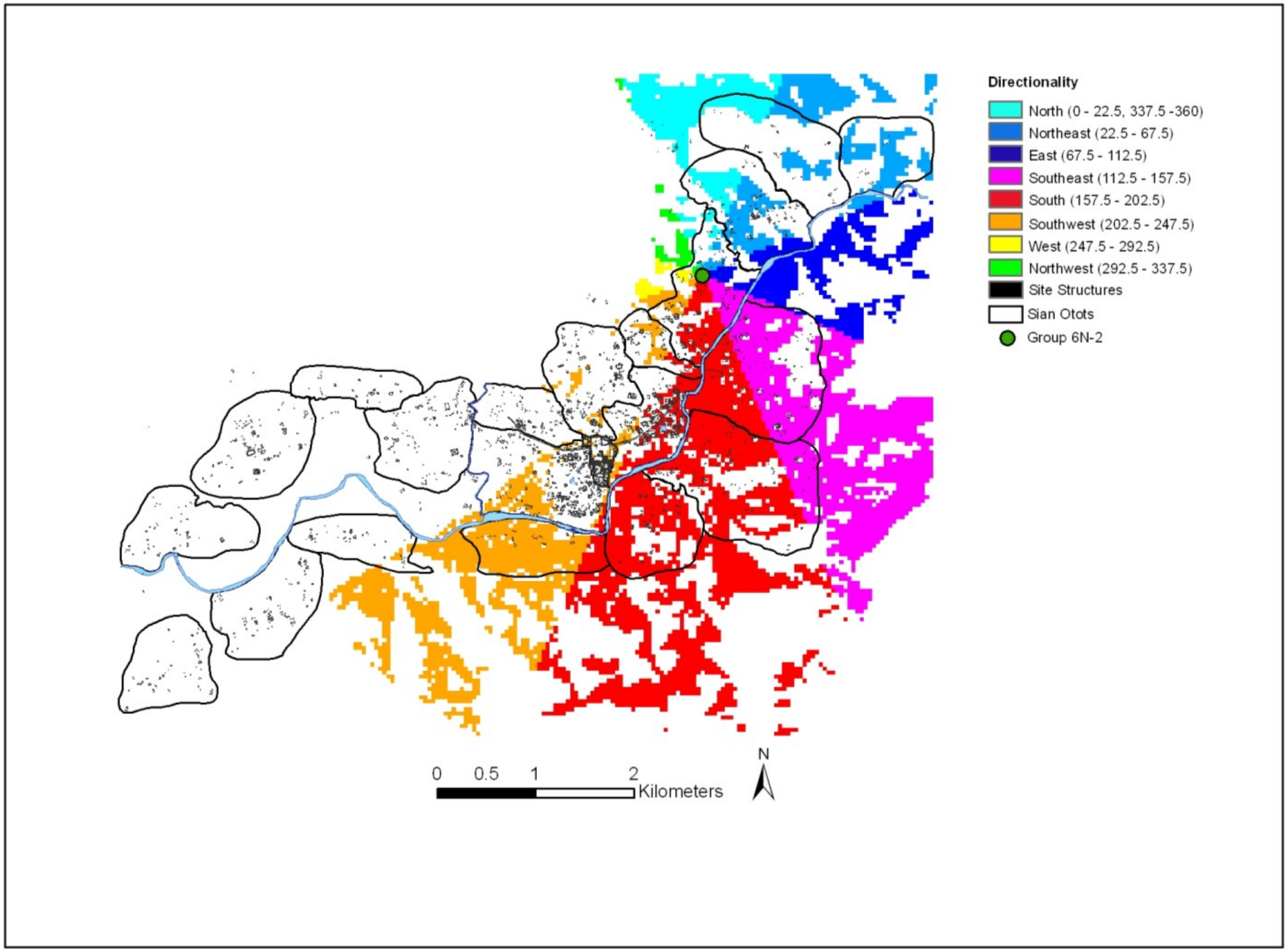


Figure 9.22: **Directionality map for Group 6N-2 in Rastrojon, Copán**

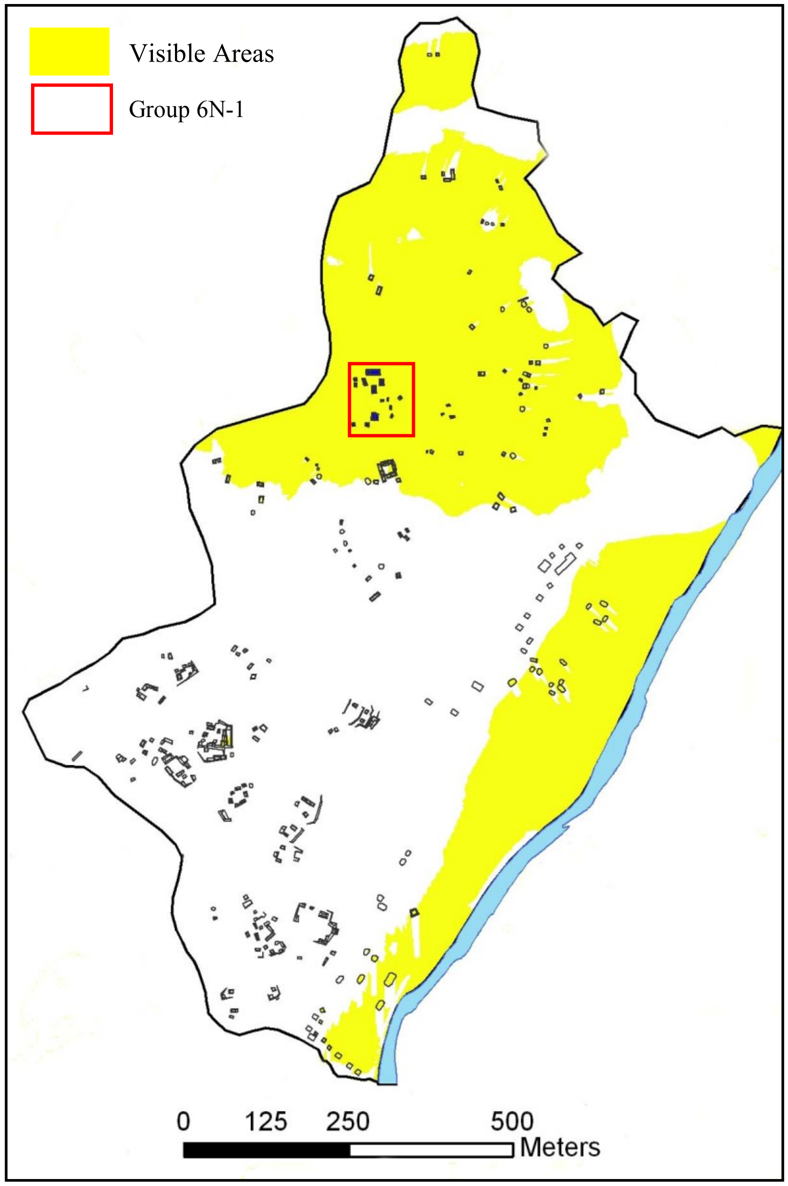


Figure 9.23: **Intra-community visibility of Group 6N-1 in Rastrojon**

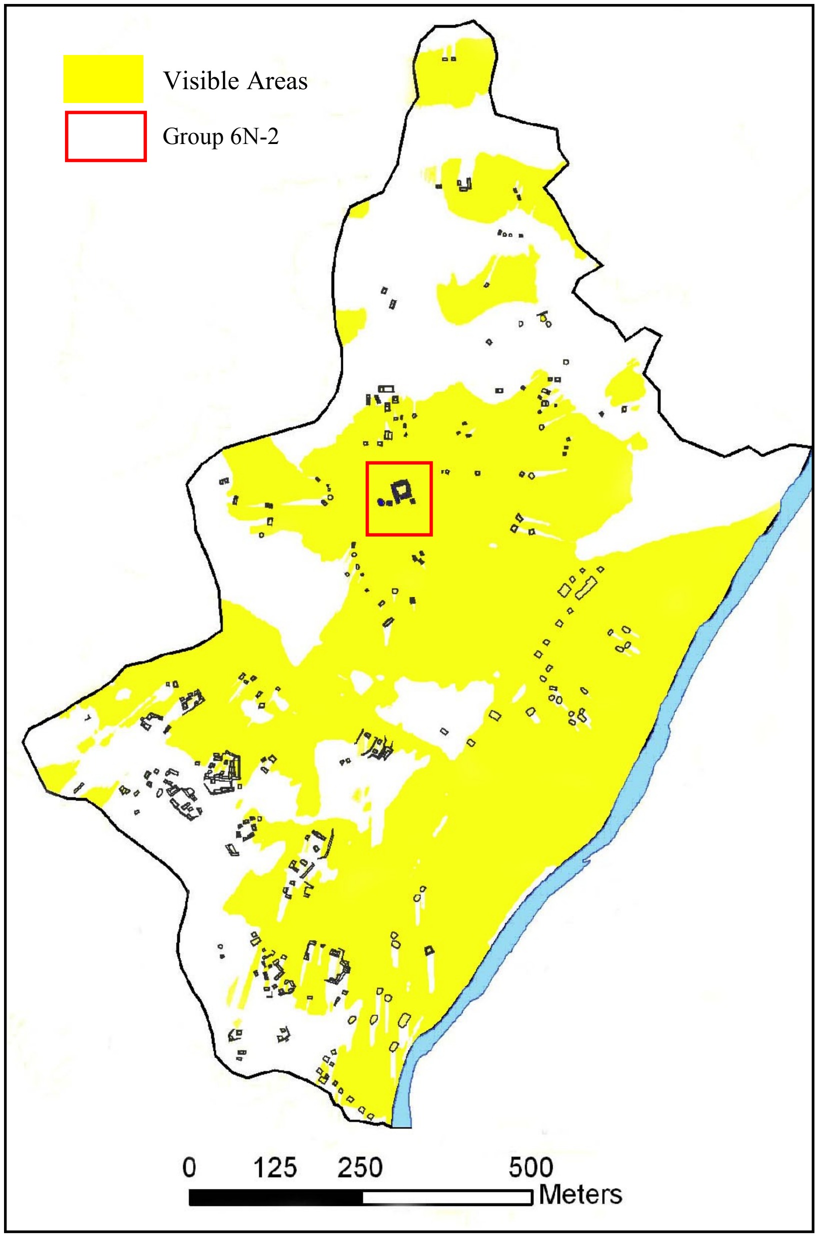


Figure 9.24: **Intra-community visibility of Group 6N-2 in Rastrojon**

Mesa de Petapilla

The sub-community of Mesa de Petapilla contains two type 3 sites, Groups 5O-1 and 5O-8, identified as paired residences (Leventhal 1979; W. Fash 1983a). A comparison of mid-distance directionality maps shows that Group 5O-8, the southern site, had a larger and less punctuated visual domain than its northern "twin," Group 5O-1 (Figures 9.25 and 9.26). The larger visual domain means that Group 5O-8 addressed a wider audience and was more visually prominent. While the occupants of many sites, especially those located within a 2.2 kilometer radius of the site, were able to see Group 5O-8, very few Copanecos were able to see Group 5O-1. Group 5O-8's visual prominence made it more visually dominant than Group 5O-1.

A comparison of the size and complexity of the two sites shows that Group 5O-1 was much larger, had a greater number of structures and plazas, (that is, was not isolated), and appears to have been less formalized. In contrast, Group 5O-8 was smaller and more formally laid out, and its structures were restricted to a single isolated plaza. The possible presence of a single structure that appears to have been much larger than the others and its abutment against a hill to make it appear even larger (Figure 9.27) may indicate a ritual function for the whole site or for the building (Leventhal 1979, 1981; Lucero 2007). The near-distance visual domains in Figures 9.28 and 9.29 indicate that Group 5O-8 targeted a larger local audience than Group 5O-1 suggesting that it may have served a public or overseeing function. These findings replicate the pattern identified for Rastrojon's paired sites, 6N-1 and 6N-2.

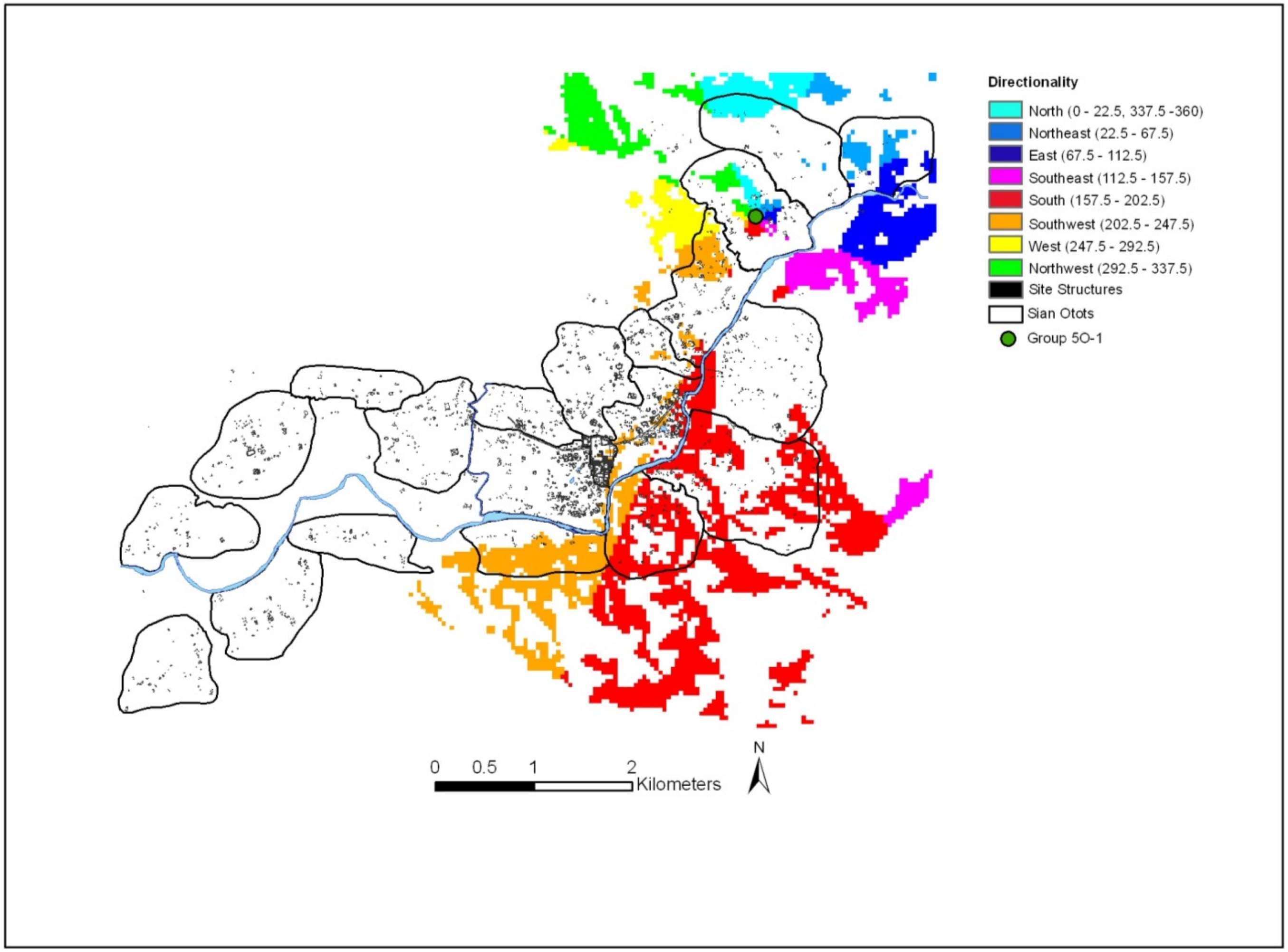


Figure 9.25: **Directionality map for Group 5O-1 in Mesa de Petapilla, Copán**

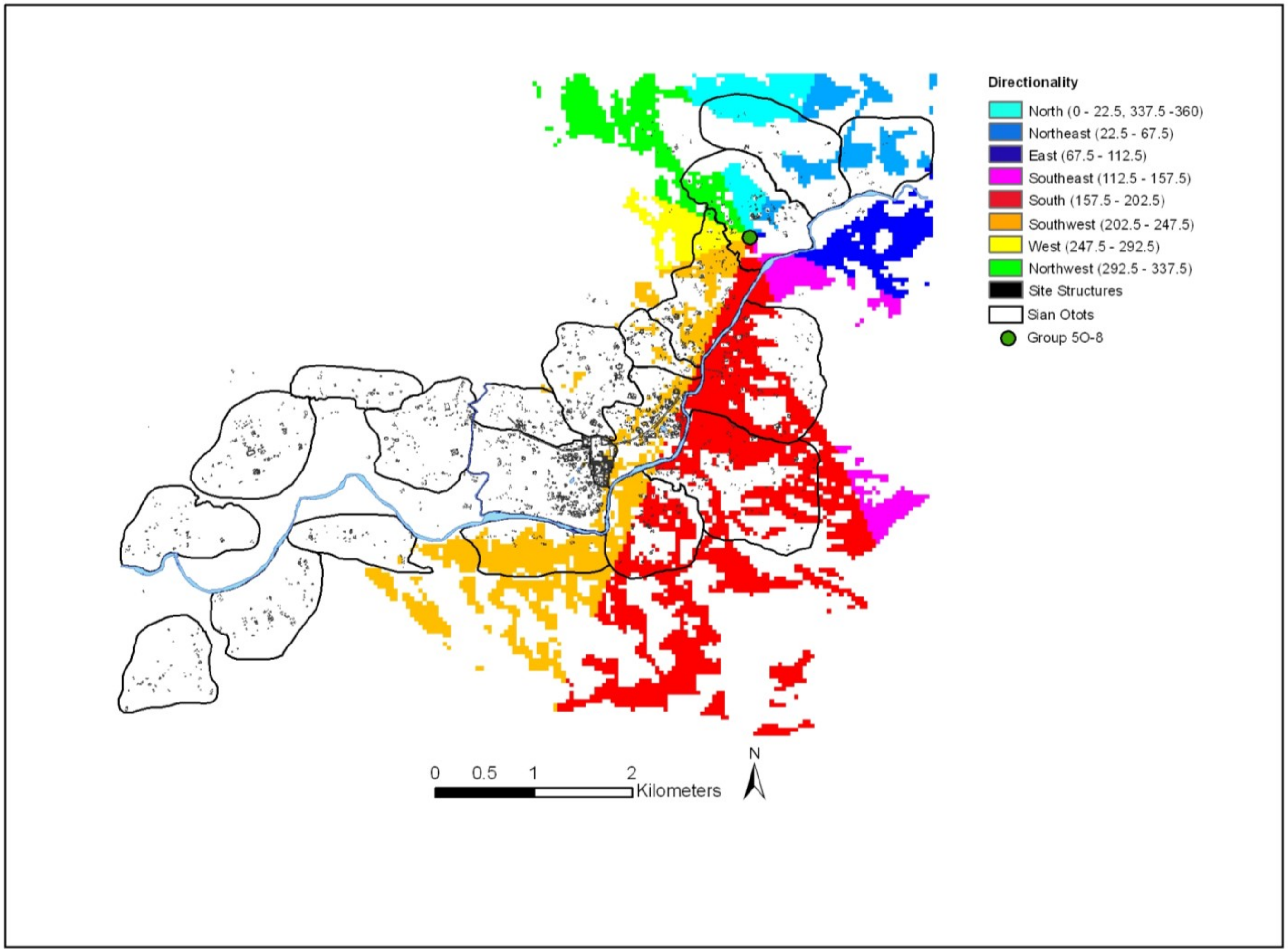


Figure 9.26: **Directionality map for Group 5O-8 in Mesa de Petapilla, Copán**

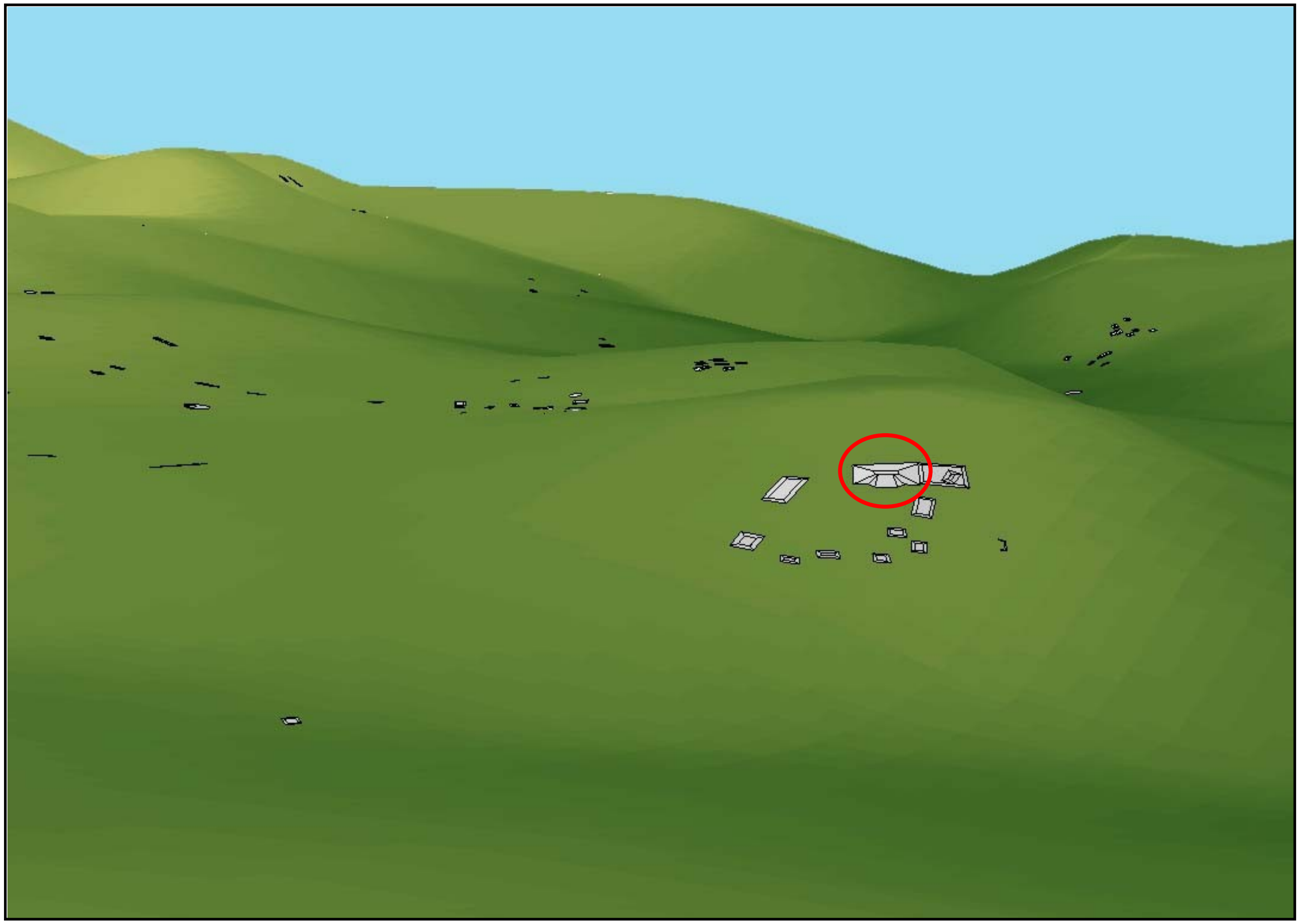


Figure 9.27: **ArcScene reconstruction for Group 5O-8 on hillside in Mesa de Petapilla, Copán**

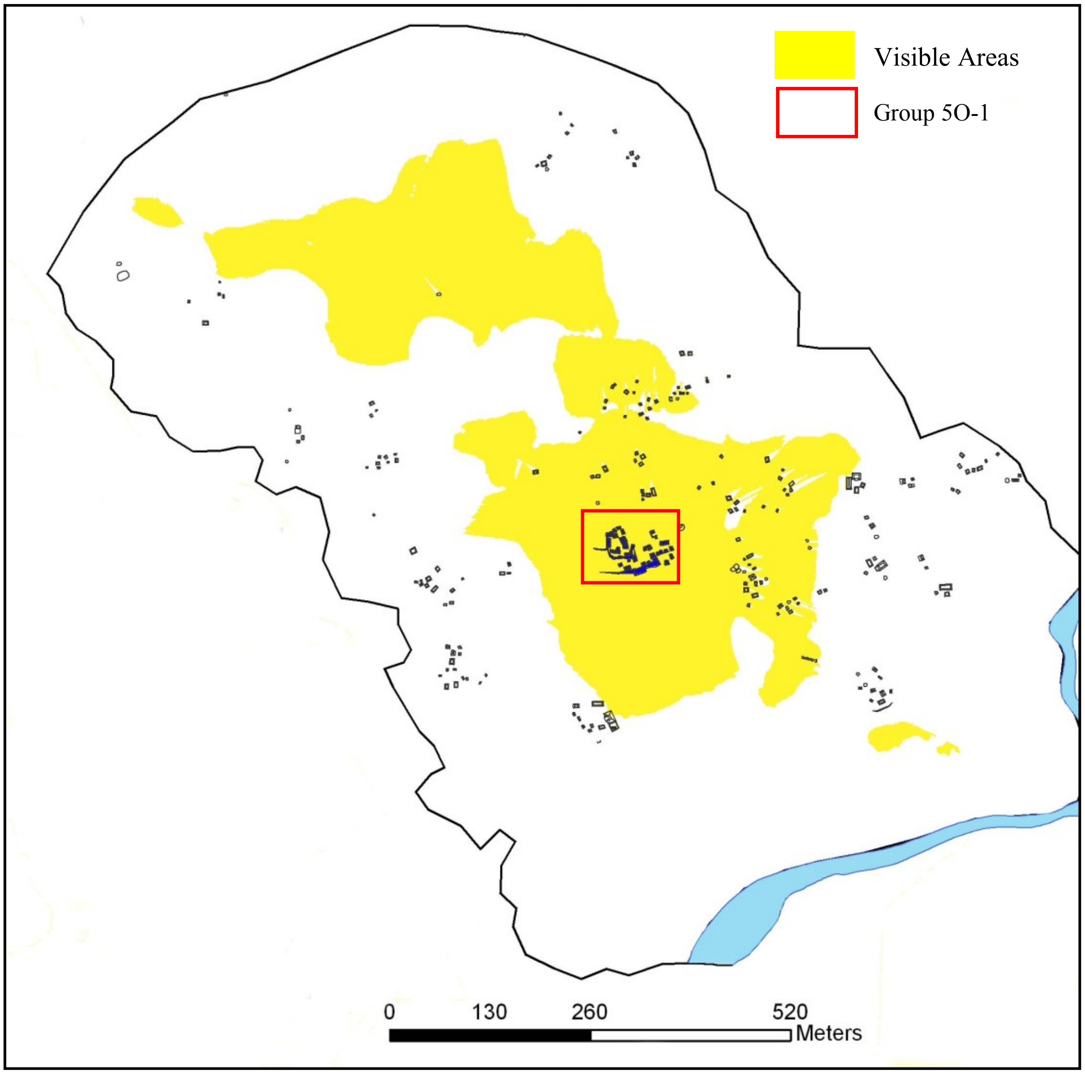


Figure 9.28: **Intra-community visibility of Group 5O-1 in Mesa de Petapilla**

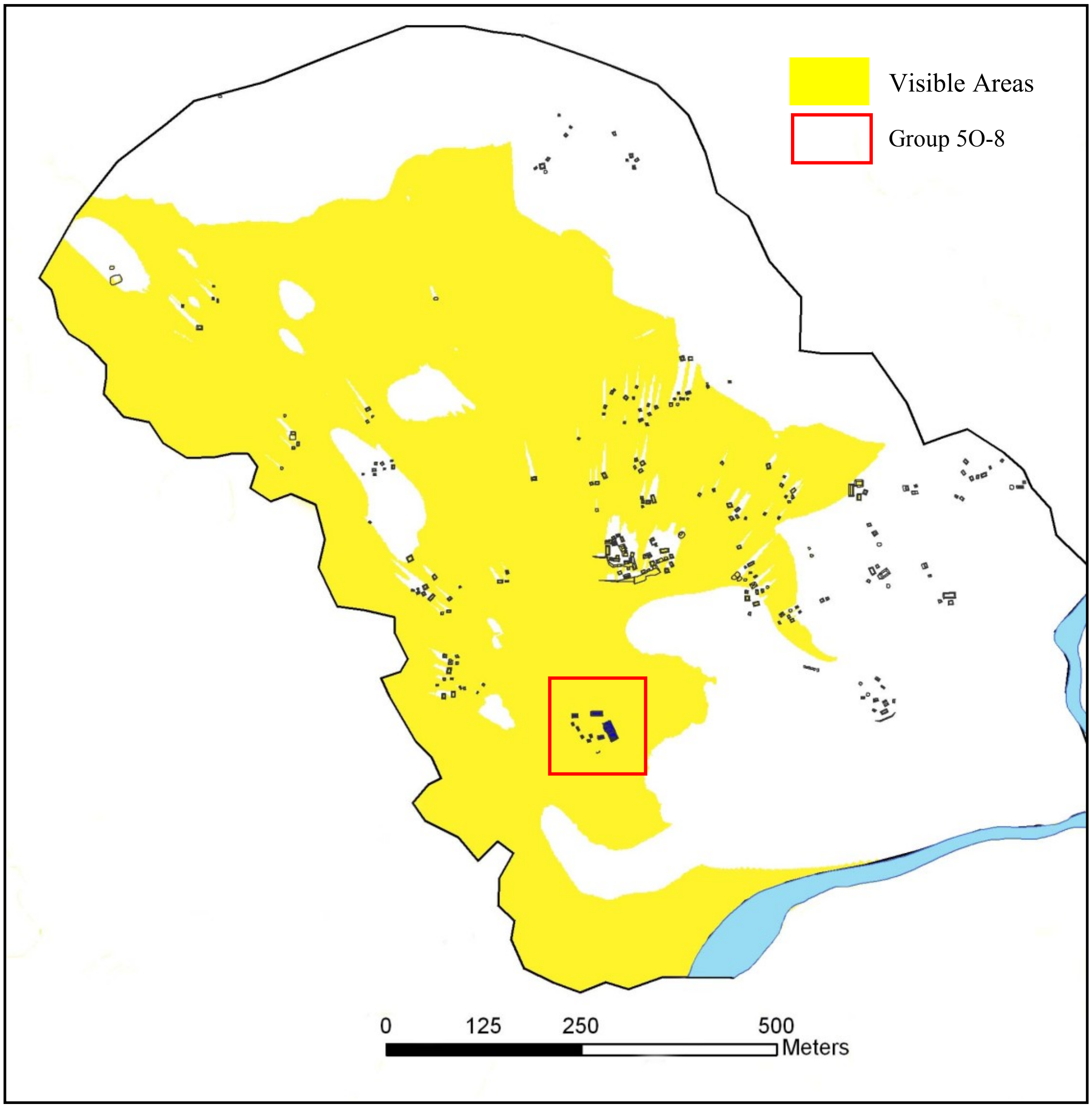


Figure 9.29: **Intra-community visibility of Group 5O-8 in Mesa de Petapilla**

Bolsa de Petapilla

Bolsa de Petapilla contains two non-paired type 2 residences, Groups 3O-8 and 3P-3. The directionality maps indicate that these groups had very similar visual domains (Figures 9.30 and 9.31). Although both sites were visible to a few local type 1 sites, only Group 3P-3 was visible to sites outside the sub-community. However, this visibility was limited to two type 2 sites in San Lucas (Groups 11M-10 and 11M-11). The results suggest very little visual connection with inhabitants in other parts of the valley. Therefore, not only was the area marginally located, it was also visually secluded. These results conform to the access results indicating that the sub-community had low degrees of social connectivity with the rest of the valley. The directionality map shows that the group's visual domains extended to the north and to the northeast beyond the Copán Valley, possibly suggesting a connection to these areas; however, because the Digital Elevation Model (DEM) does not extend to these areas, it is not currently possible to investigate the extent of these views.

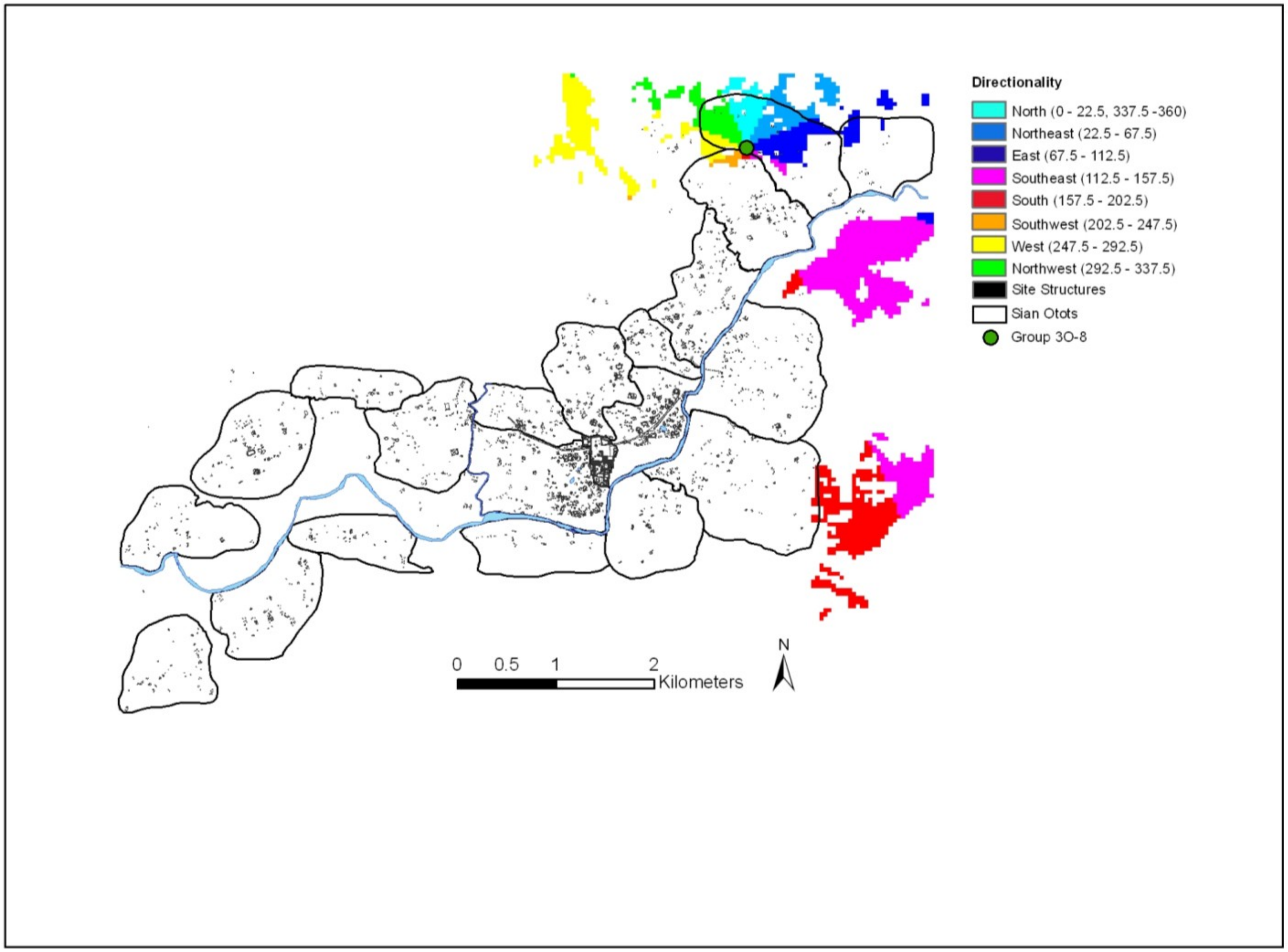


Figure 9.30: **Directionality map for Group 3O-8 in Bolsa de Petapilla, Copán**

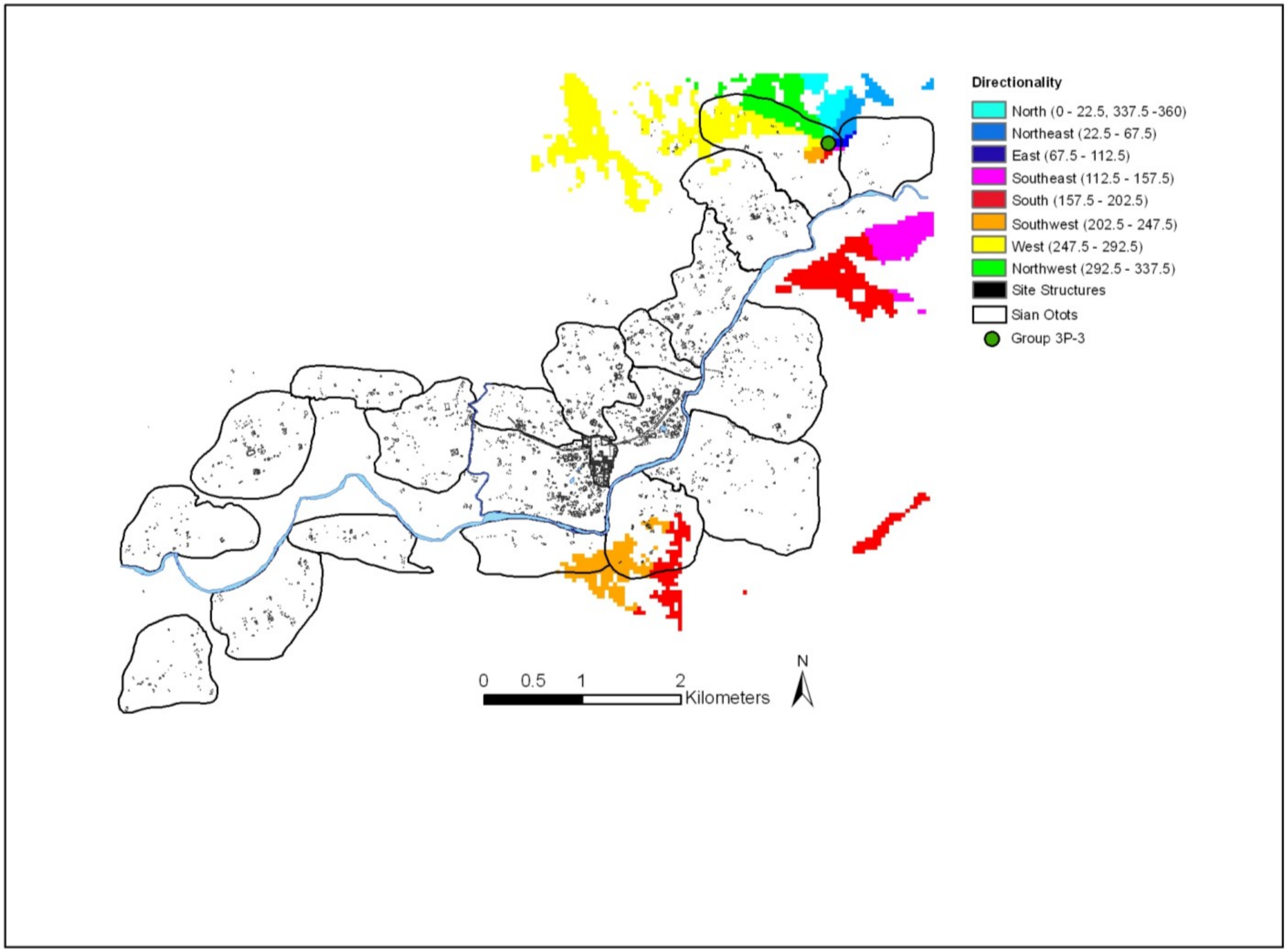


Figure 9.31: **Directionality map for Group 3P-3 in Bolsa de Petapilla, Copán**

Titoror

Despite the fact that Titoror houses only a few scattered type 1 sites, its prestige was most likely elevated by the presence of Stela 13, a freestanding monument possibly marking the eastern entrance of the valley (W. Fash 1983a). Two sites, Groups 4Q-2 and 4Q-3, which are slightly larger than the rest of the sub-community's sites, overlook Stela 13. The directionality maps illustrate that, for the most part, the two groups have similar visual domains (Figure 9.32 and 9.33), that are relatively limited within the valley. Like its western neighbor, Bolsa de Petapilla, both its access and visibility results suggest low degrees of social connectivity to other residents in the valley.

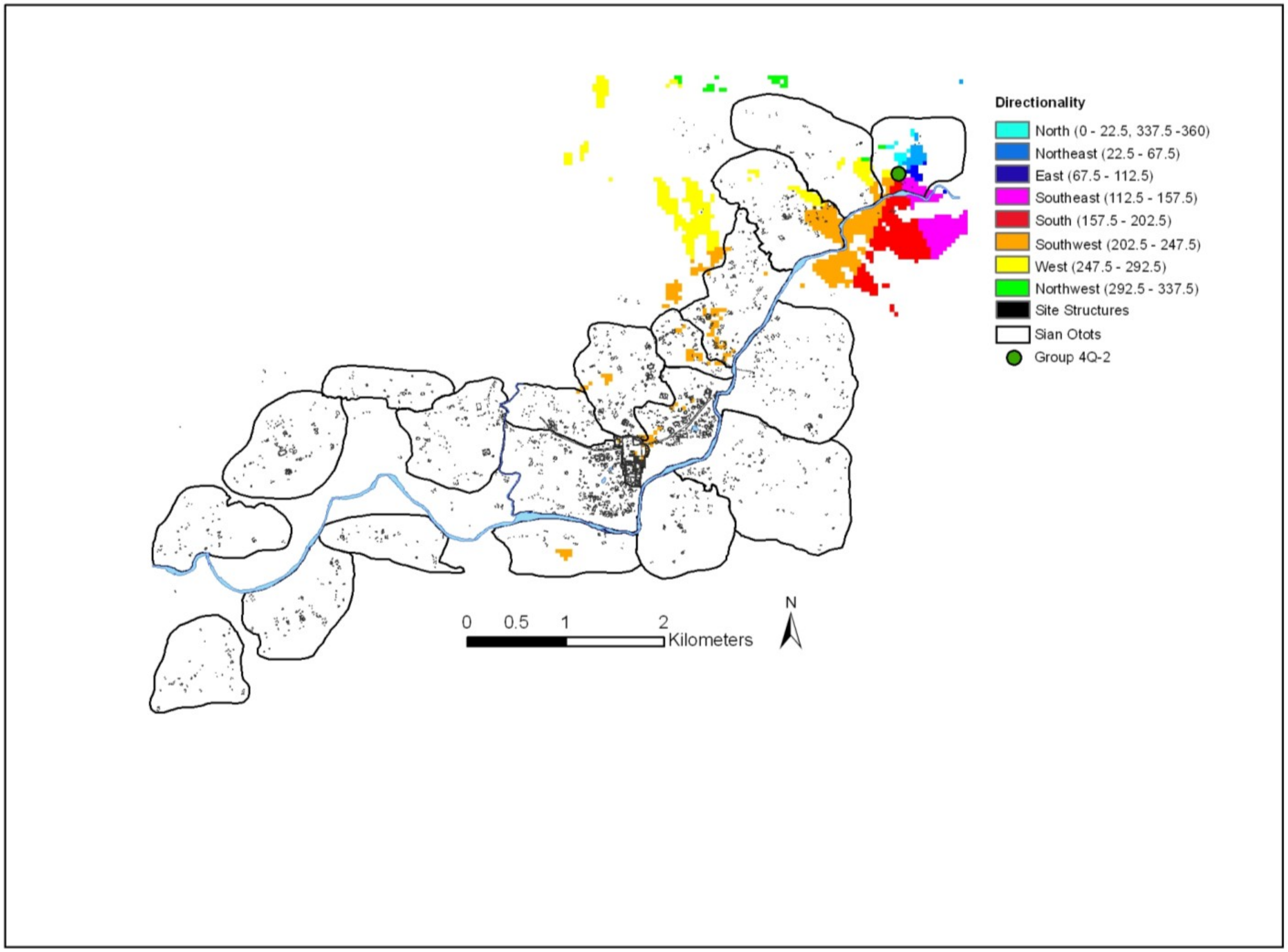


Figure 9.32: **Directionality map for Group 4Q-2 in Titoror, Copán**

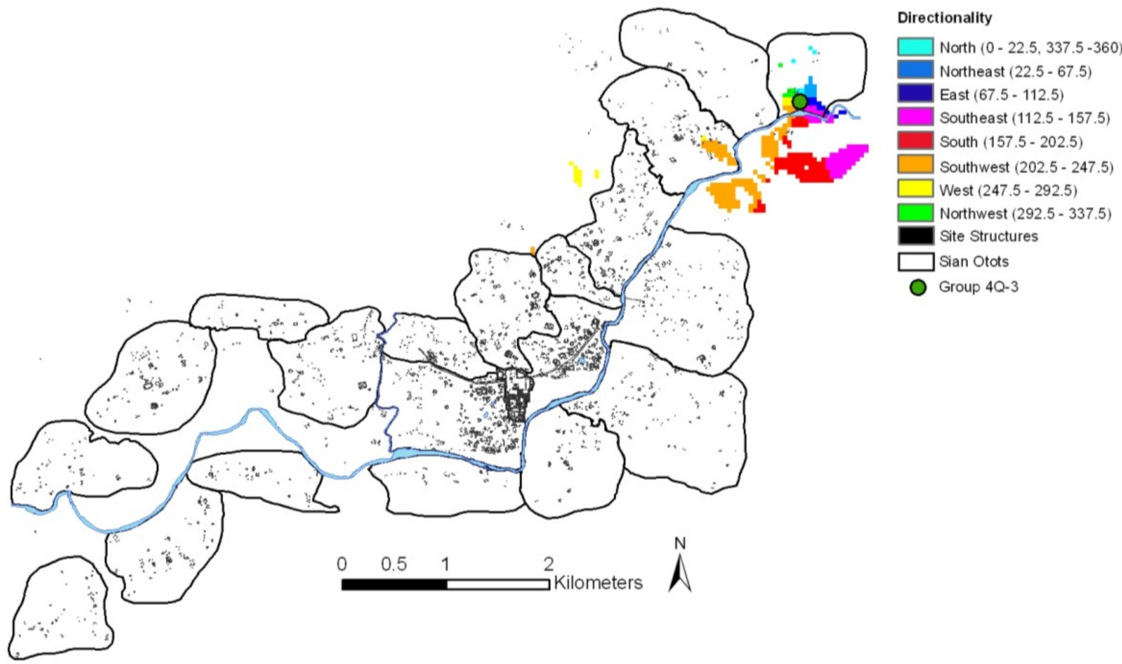


Figure 9.33: **Directionality map for Group 4Q-3 in Titoror, Copán**

Zone 4—Steep-sided Hills South of River

Titichon

The sub-community of Titichon contains five type 2 sites. I analyzed three of these sites, Groups 9P-1 and 9P-5, which form a paired residence, and Group 8O-2 (Figure 9.34). The directionality maps for Groups 9P-1 and 9P-5 indicate that the most prominent views for both groups were to the west, northwest, and southwest (Figures 9.35 and 9.36). Interestingly, neither group had strong visual ties with other sites in Titichon. Instead, their visual domains focused into the valley, toward areas of high settlement density and the Principal Group. Unlike the paired residences in Mesa de Petapilla and Rastrojon paired, these two groups had similar visual domains.

Despite the similarities in their visual domains, the two groups in Titichon have marked differences in architecture and spatial arrangement. Group 9P-1 is on slightly higher ground, stands in relative isolation, is more formally organized, and appears to have one structure that is markedly larger than the others at the site. These characteristics suggest that despite their similar visual domains, Group 9P-1 may have played a different role in society than did Group 9P-5.

The visual domain of Group 8O-2, located in the northeastern part of Titichon alongside the Río Copán, exhibits two important differences from the visual domains of Groups 9P-1 and 9P-5 (Figure 9.37). First, Group 8O-2's visual domain is markedly smaller. Second, it addresses residents within Titichon. These differences suggest that the occupants of Group 8O-2 targeted a local audience, whereas the residents of Groups 9P-1 and 9P-5 targeted a wider audience extending beyond the sub-community boundaries. These results suggest that Groups 9P-1 and 9P-5 may have been members of a distinct sub-community, that is, they were not actually part of Titichon, but belonged to a more upland sub-community than their neighbors living at Group 8O-2 along the river. The larger visual domains of these paired sites invite the possibility that one or both of these sites had distinct functions. Given that the formal characteristics of Group 9P-1 replicate those for Groups 6N-2 and 5O-8 in Rastrojon and Mesa de Petapilla, respectively, I posit that the differences (whether functional, social, ethnic, and/or temporal) between the two sites may be the same for each of the paired sites examined thus far.

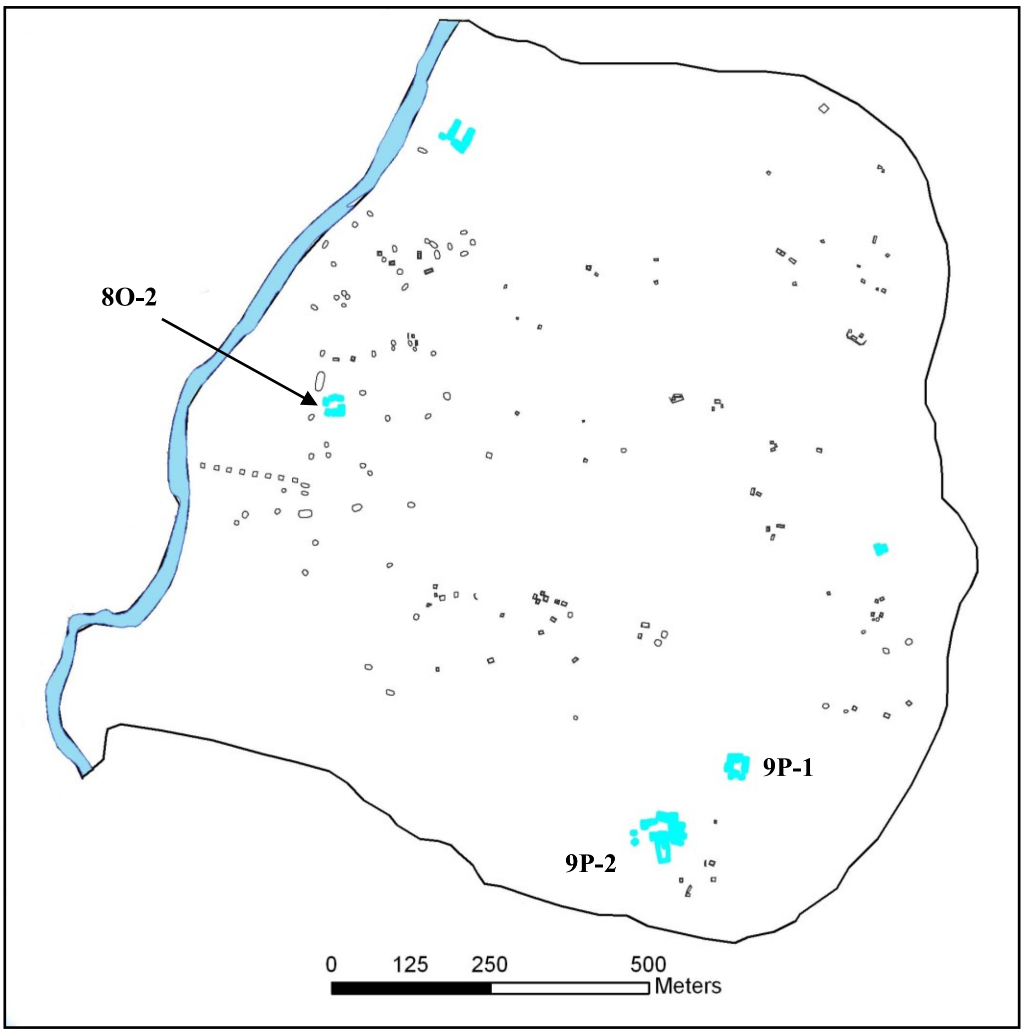


Figure 9.34: **Type 2 sites in Titichon**

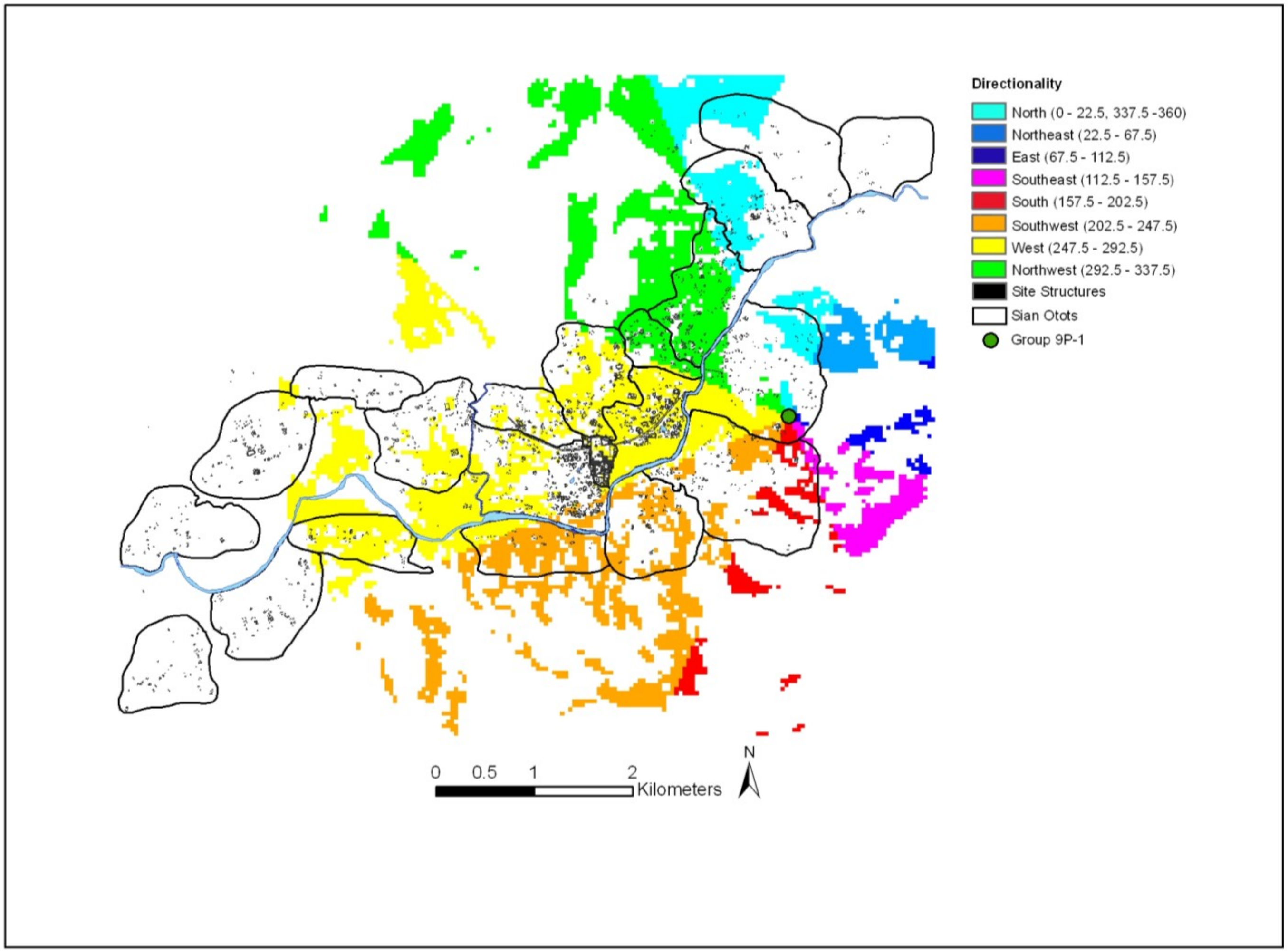


Figure 9.35: **Directionality map for Group 9P-1 in Titichon, Copán**

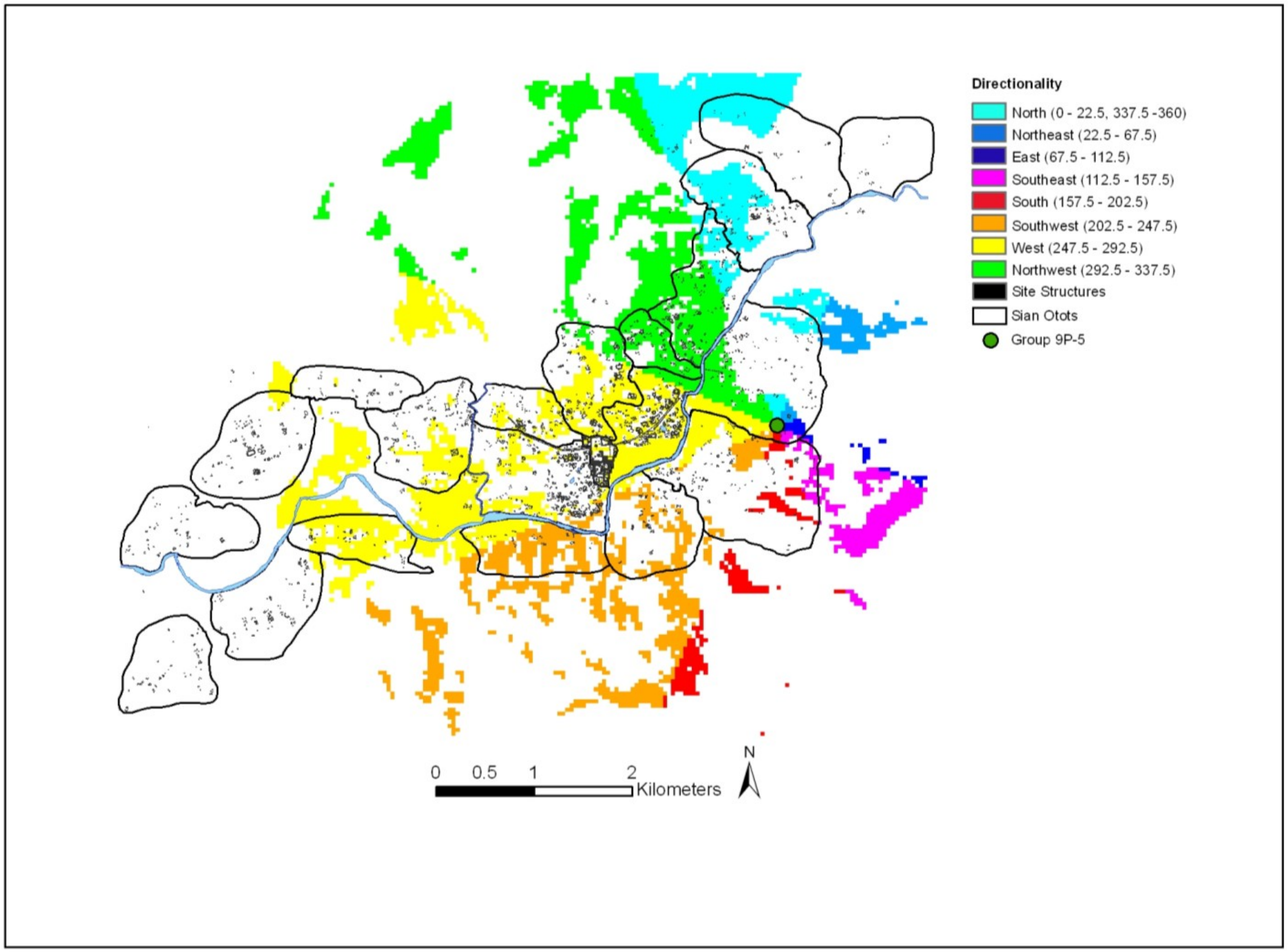


Figure 9.36: **Directionality map for Group 9P-5 in Titichon, Copán**

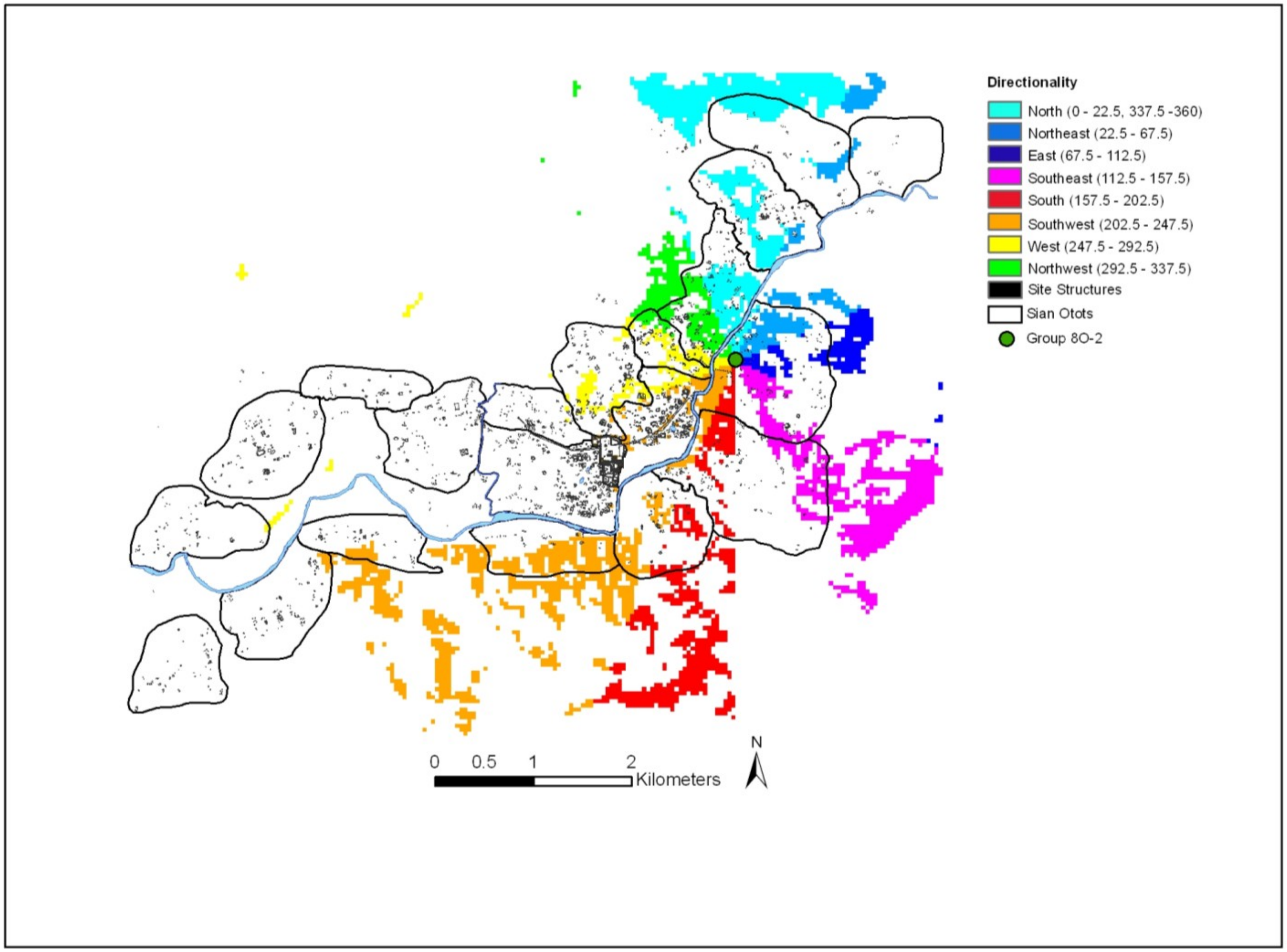


Figure 9.37: **Directionality map for Group 8O-2 in Titichon, Copán**

San Rafael

San Rafael has three type 2 sites. I compared the visual domains of two of these sites—Groups 10P-4 and 10O-7. Group 10P-4 is located along the sub-community's eastern boundary and is relatively isolated. In contrast, Group 10P-7, a smaller architectural complex, is on the outskirts of the sub-community's most populated area.

The directionality maps in Figures 9.38 and 9.39 illustrate that both groups were visually tied to many Zone 3 households, the residents of Las Sepulturas, and the large ceremonial buildings of the Principal Group. Additionally, unlike many other eastern valley sites, both groups were visible to sites located in the west-central part of the valley. Although both groups have similar mid-distance domains, their near-distance domains are markedly different. Within the boundaries of San Rafael, the two groups are visible to distinctly different areas. Group 10P-4 was visible to sites in the center of the sub-community, while Group 10O-7 was visible to sites along its edges (Group 10P-4 was visible to 14 local sites, and Group 10O-7 was visible to 11 local sites). The differences in their visual domains suggest that the residents of these dominant households were addressing different local audiences.

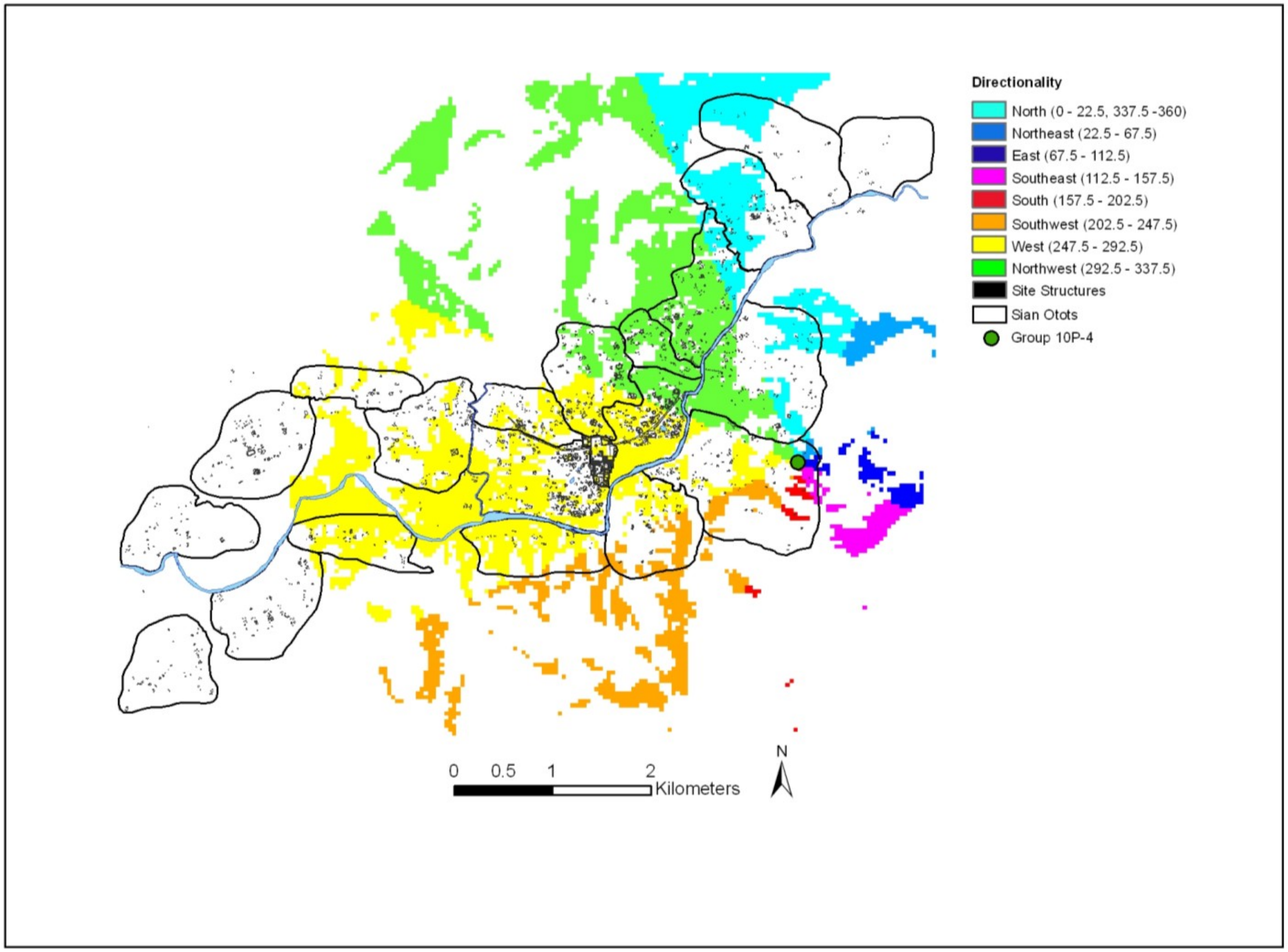


Figure 9.38: **Directionality map for Group 10P-4 in San Rafael, Copán**

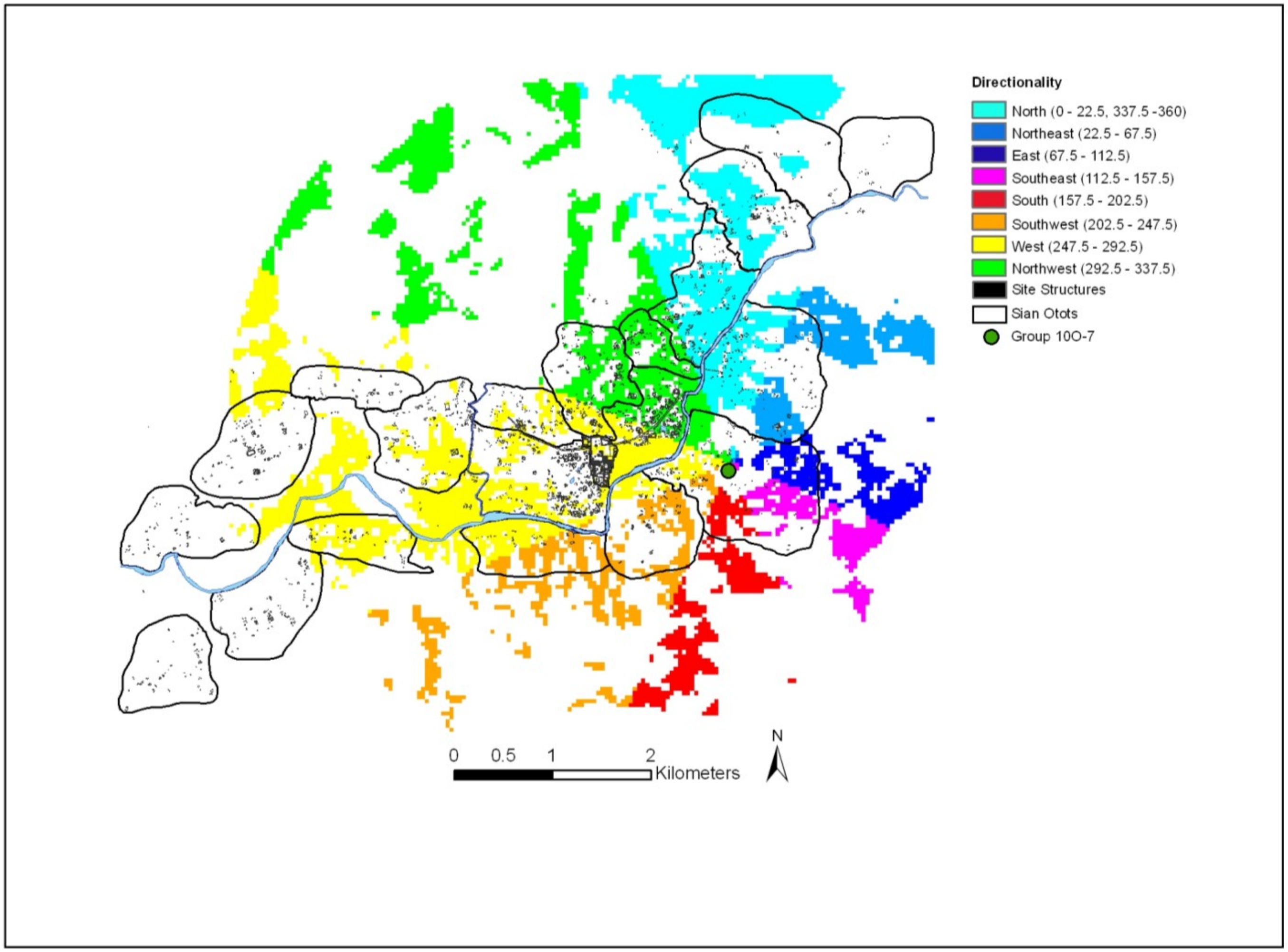


Figure 9.39: **Directionality map for Group 10O-7 in San Rafael, Copán**

San Lucas

The sub-community of San Lucas has four type 2 sites, two of which (Groups 11M-10 and 11M-11) are so close together they may actually have been one site. The northern site, Group 11M-10, is less than 15 meters from its southern counterpart, Group 11M-11. The directionality map indicates that Groups 11M-10 and 11M-11 had an expansive visual domain that encompassed sites in Zones 2, 3, and 4 (Figure 9.40). The people living at these sites were also visually connected to most other San Lucas residents.

In contrast, the residents of Group 12M-1, a relatively formalized group approximately 170 meters to the south, had a much smaller visual domain.They had almost no visual ties to other San Lucas residents, but instead were linked to sites in the west-central part of the valley and directed toward the Principal Group (Figure 9.41).

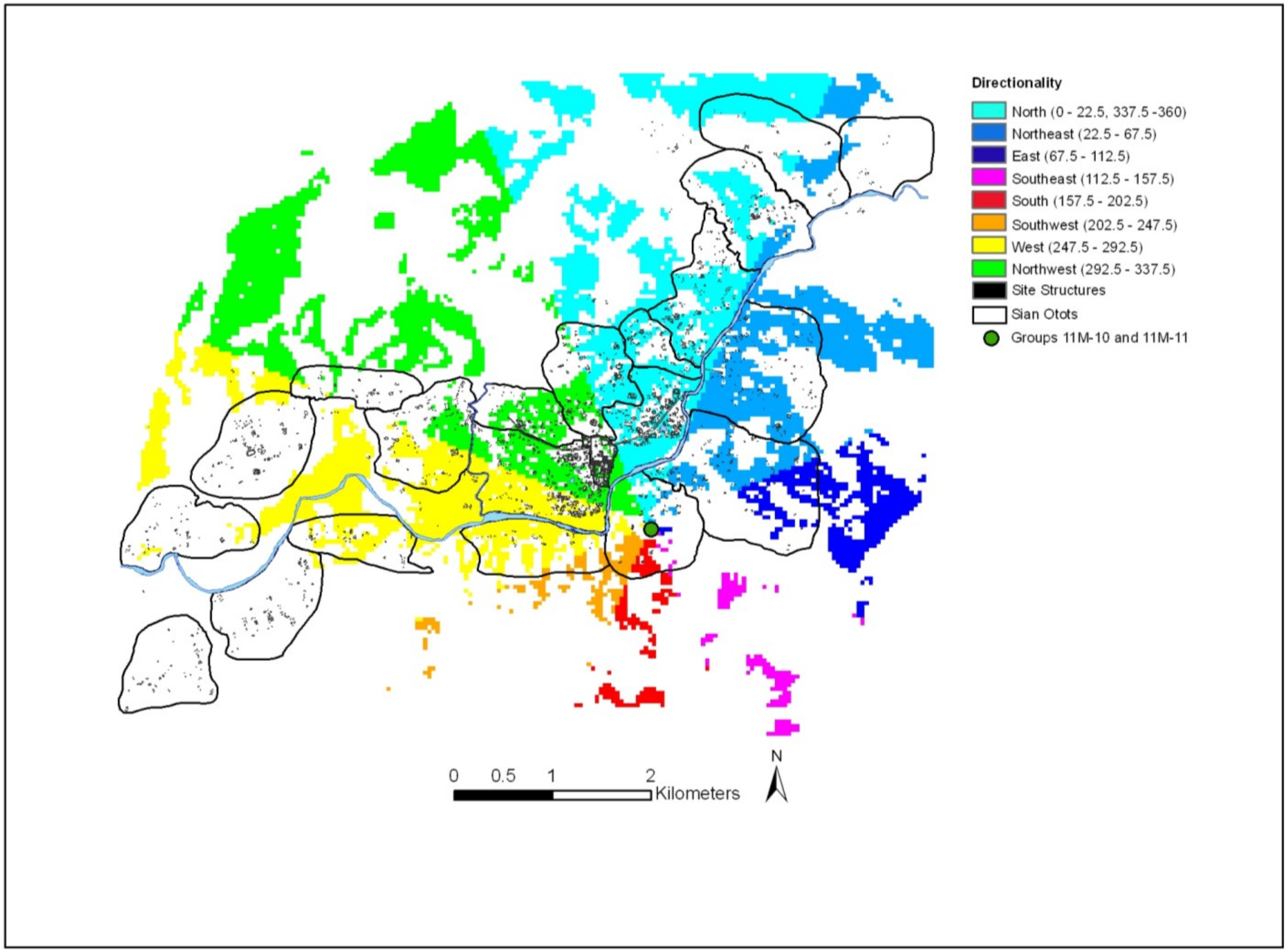


Figure 9.40: **Directionality map for Groups 11M-10 and 11M-11 in San Lucas, Copán**

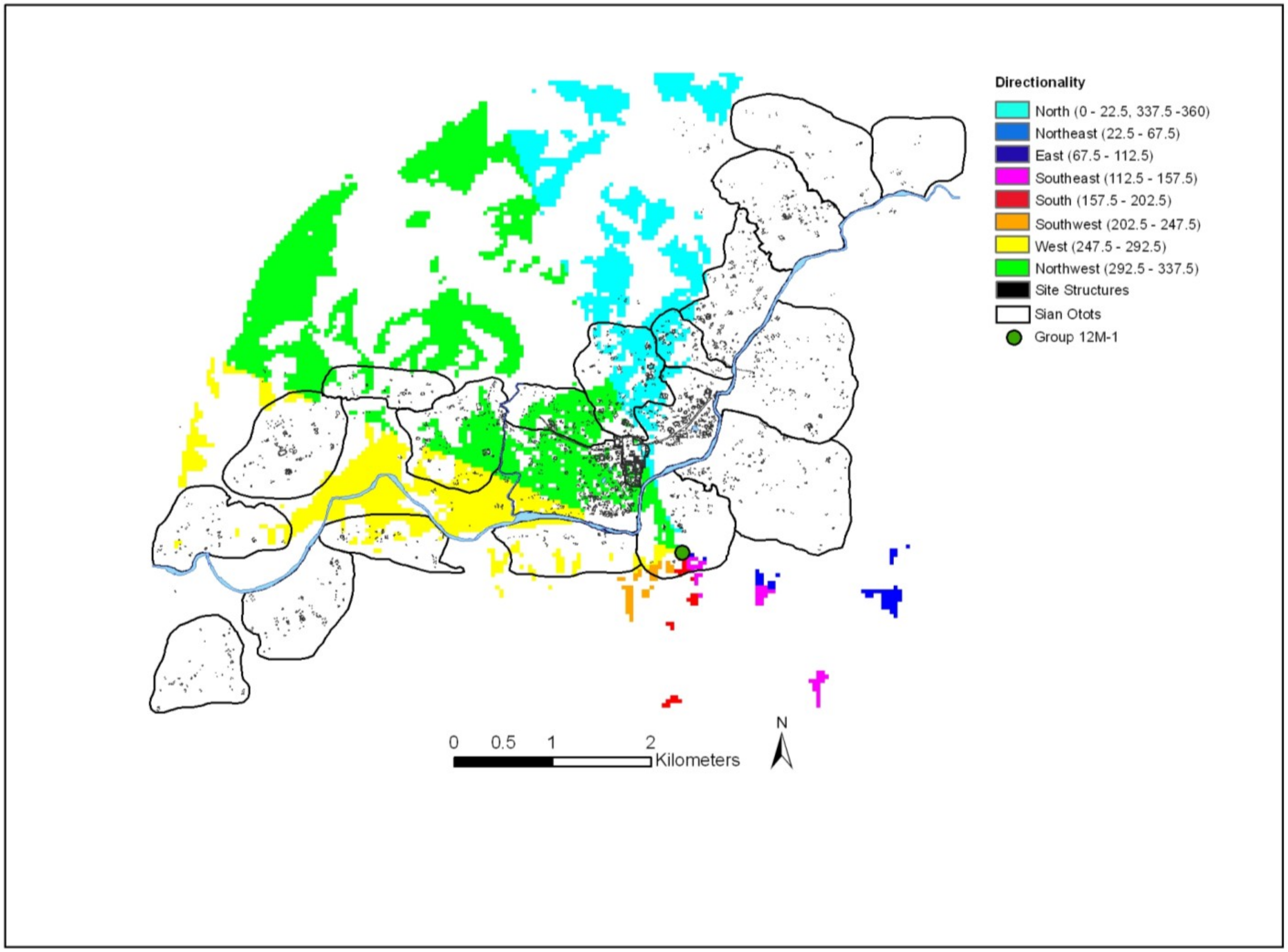


Figure 9.41: **Directionality map for Group12M-1 in San Lucas, Copán**

El Puente

El Puente has one type 2 site, Group 12L-1. The directionality map (Figure 9.42) indicates that its visual domain encompassed many households in the sub-communities of El Bosque, El Pueblo, and Comedero, some sites in the eastern sub-communities of San Lucas, San Rafael, and Titichon, and a few scattered sites in other parts of the valley. Despite the group's relatively large visual domain, it was visible only to two El Puente households. These results suggest that either the group's residents may have not played a dominant role in sub-community level affairs, or that they found it unnecessary to visually address local residents and instead thought it more important to visually connect to households beyond El Puente, and establish ties to people higher in the social hierarchy.

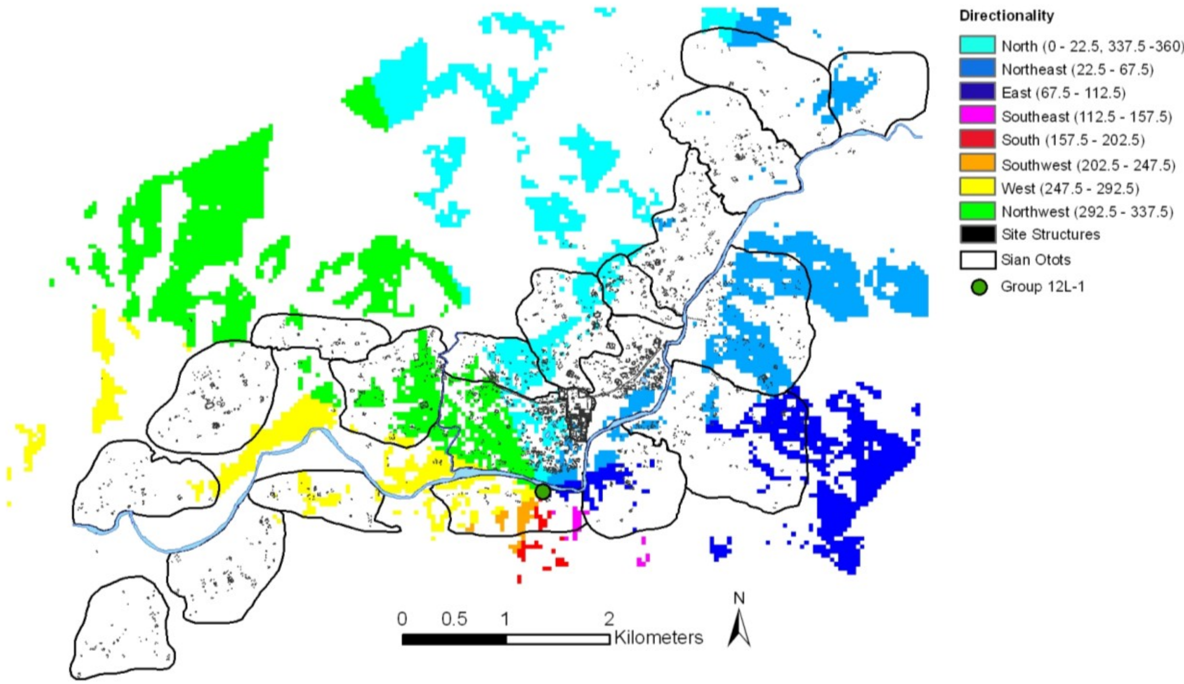


Figure 9.42: **Directionality map for Group 12L-1 in El Puente, Copán**

Zone 5—Diverse Ecological Area in Western Part of Valley

Algodonal

The sub-community of Algodonal contains one type 3 site, Group 12F-3, and several type 1 sites. Figure 9.43 shows that Group 12F-3 had very few visual ties with other valley sites. Most of the sites to which it was visually connected were scattered throughout Estanzuela, Tapescos, El Bosque, and the southern half of El Pueblo. Interestingly, this dominant household had almost no visual ties with other Algodonal sites. Instead, Group 12F-3 overlooked much of the Río Copán and its adjacent agricultural lands in the western part of the valley, suggesting that its occupants may have functioned as overseers of the agricultural lands (W. Fash 1983a; Leventhal 1979).

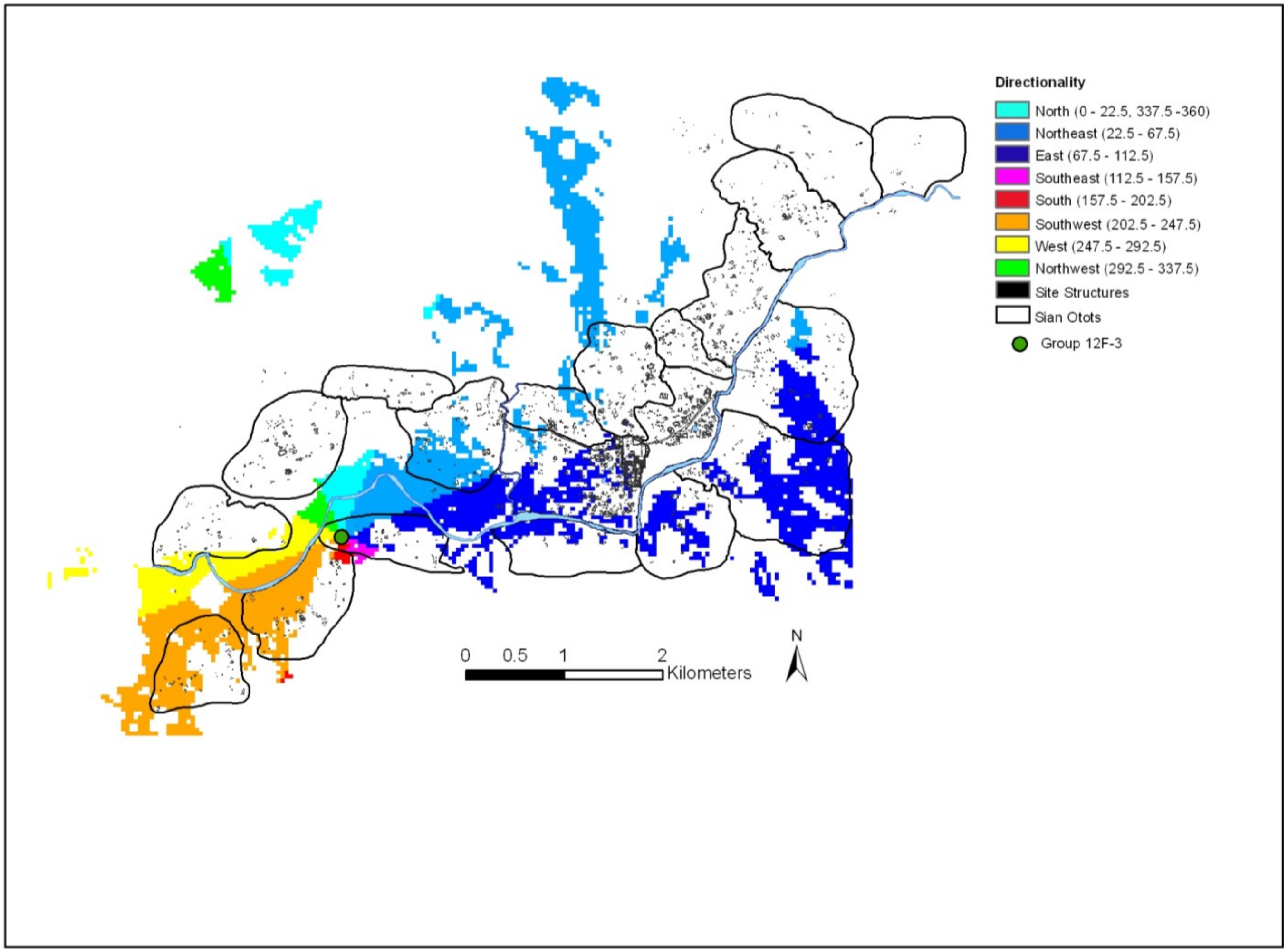


Figure 9.43: **Directionality map for Group 12F-3 in Algodonal, Copán**

Estanzuela

Estanzuela has one type 3 site and four type 2 sites. The type 3 site, Group 14F-1, is a large architectural complex with one large and somewhat isolated pyramid-like structure at the north end (Figure 9.44). Three of the type 2 sites, Groups 12F-4, 13F-1, and 13F-2, are located approximately 20 meters apart. A single large structure is located at the crossroads of these three sites, virtually connecting them into a single large, complex site (Figure 9.45). The aggregated groups become a single type 3 site that serve as a southern counterpart to Group 12F-3, located 200 meters to the north in Algodonal, and possibly point to another unidentified set of paired residences.

The directionality map for these three sites shows strong visual ties with all Estanzuela residences, as well as some sites located in Tapescos and Rincon del Buey (Figure 9.46).

Group 14F-1's directionality map indicates that the most prominent views were to the north, northwest, and west (Figure 9.47). Its visual domain encompassed much of its own sub-community as well as Tapescos and Rincon del Buey. Both groups exhibit strong intra-community visual ties and ties to households in the southern part of Rincon del Buey. Furthermore, like their northern neighbor, Group 12F-3 in Algodonal, they overlook prime agricultural lands alongside the Río Copán.

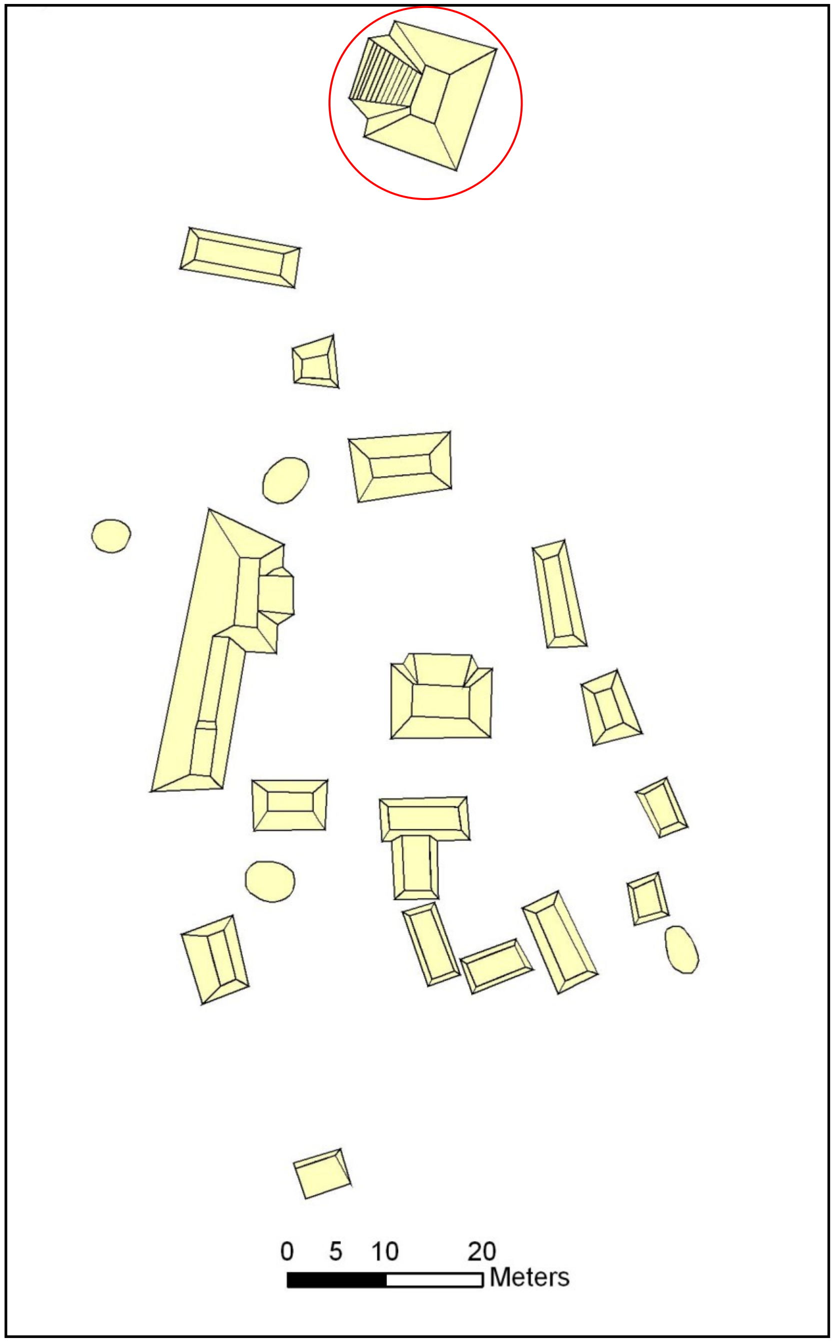


Figure 9.44: **Group 14F-1 GIS map showing large pyramid structure (based on Fash and Long 1983)**

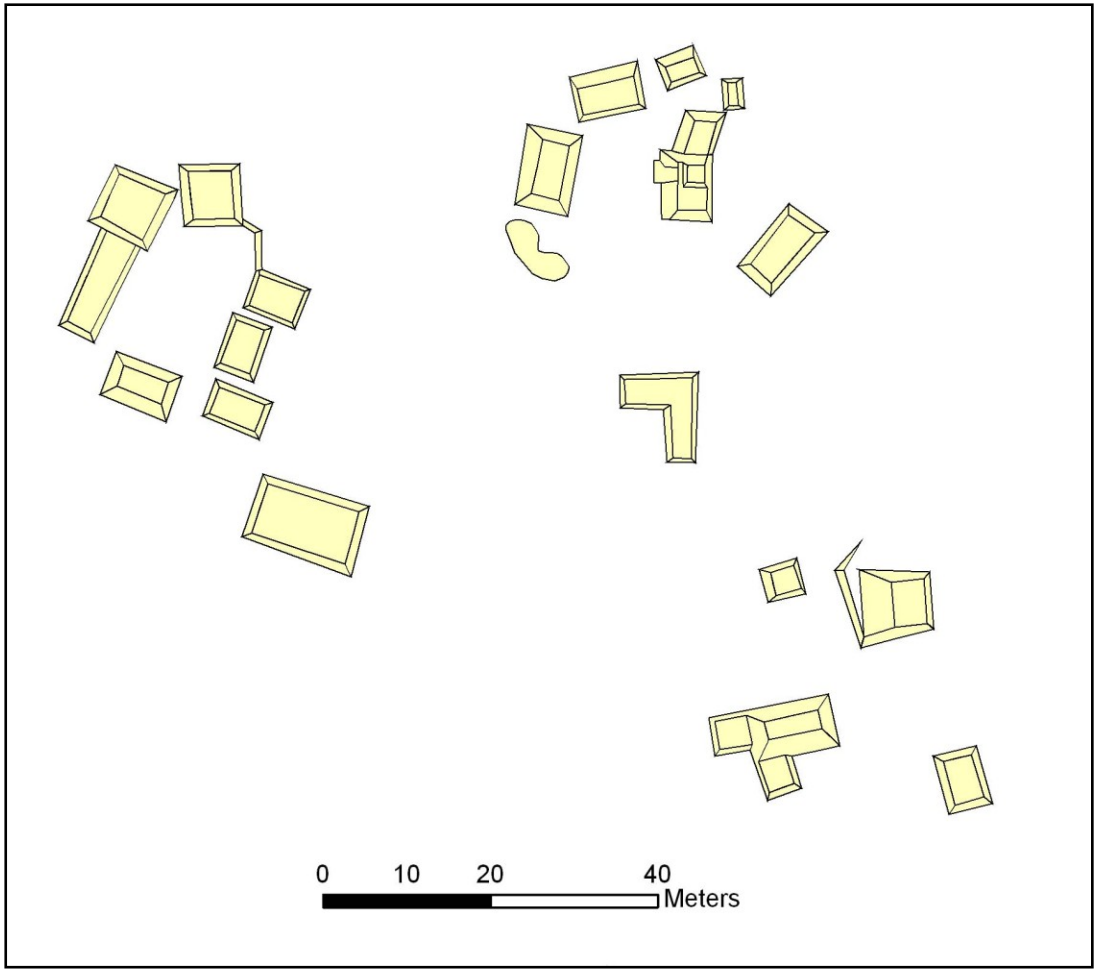


Figure 9.45: **GIS map for Groups 12F-4, 13F-1, and 13F-2 (based on Fash and Long 1983)**

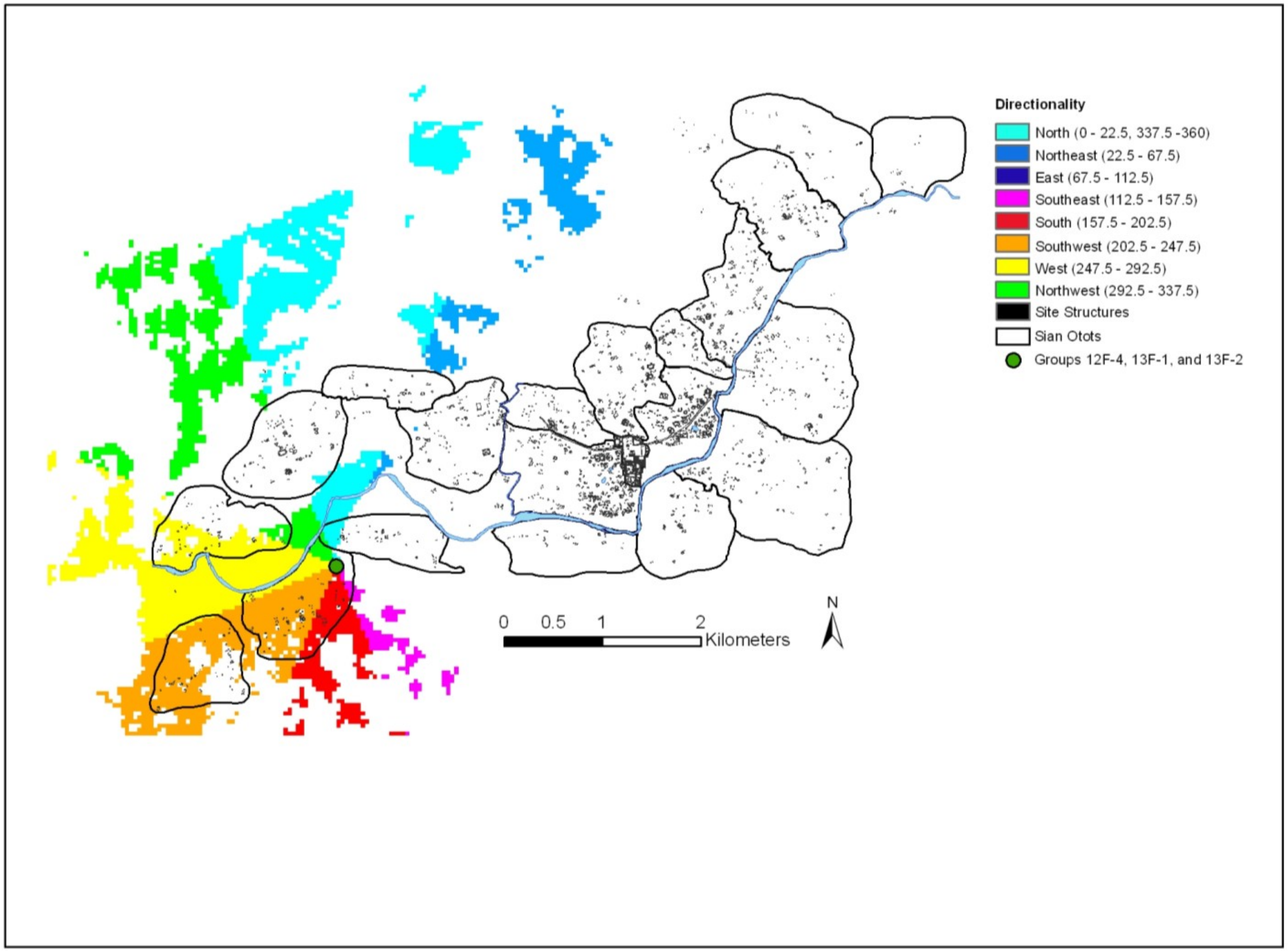


Figure 9.46: **Directionality map for Groups 12F-4, 13F-1, and 13F-2 in Estanzuela, Copán**

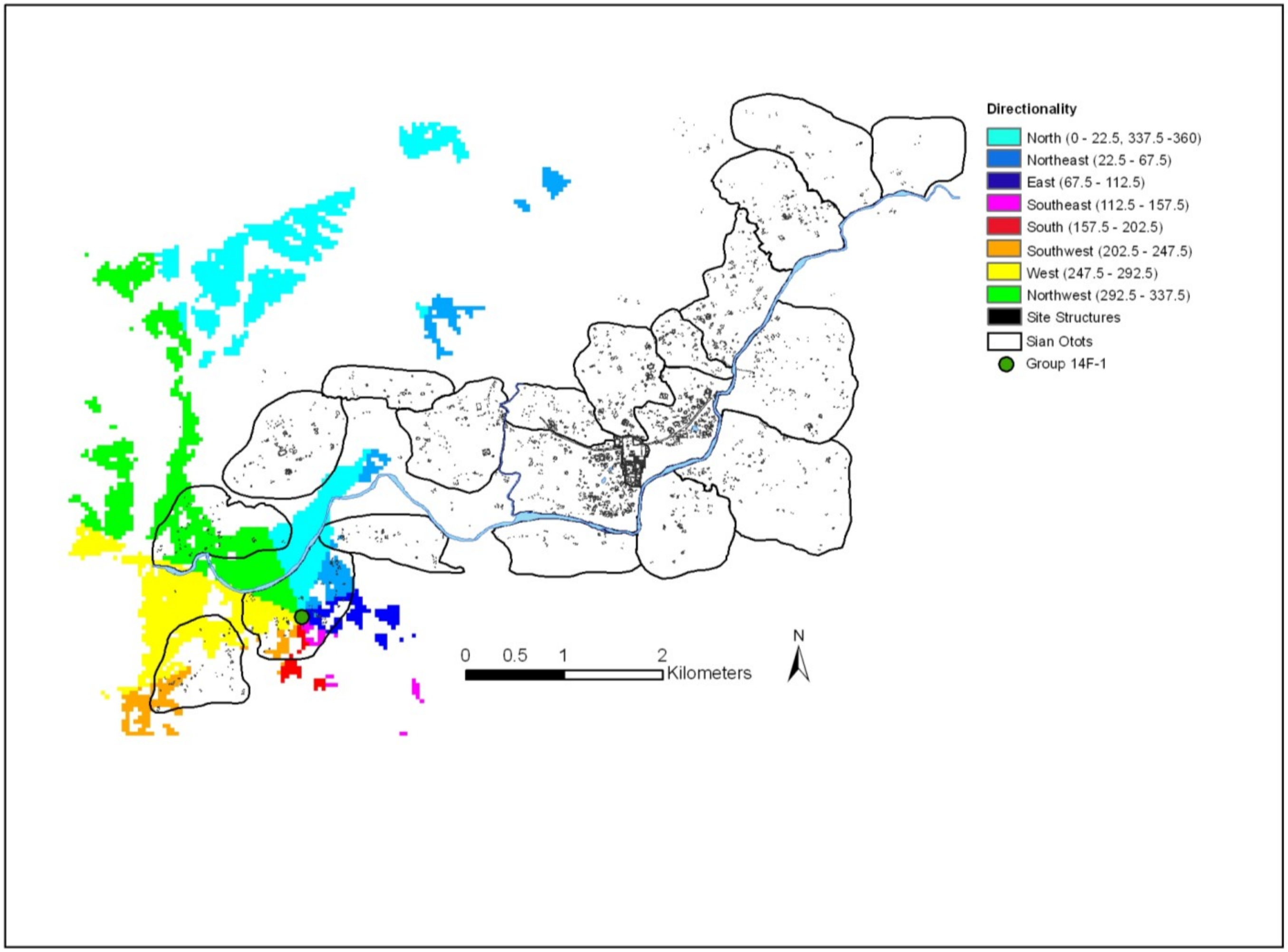


Figure 9.47: **Directionality map for Group 14F-1 in Estanzuela, Copán**

Tapescos

Although Tapescos has only type 1 sites and does not appear to have a dominant household, I evaluated directionality for one of its larger sites, Group 15D-3, to evaluate directionality. Figure 9.48 indicates that the most prominent views were to the north and that its visual domain encompassed households in Rincon del Buey. The results mirror Rincon del Buey's directionality map, suggesting a strong visual connection between the residents of these two areas, but little connection with the rest of the valley's inhabitants.

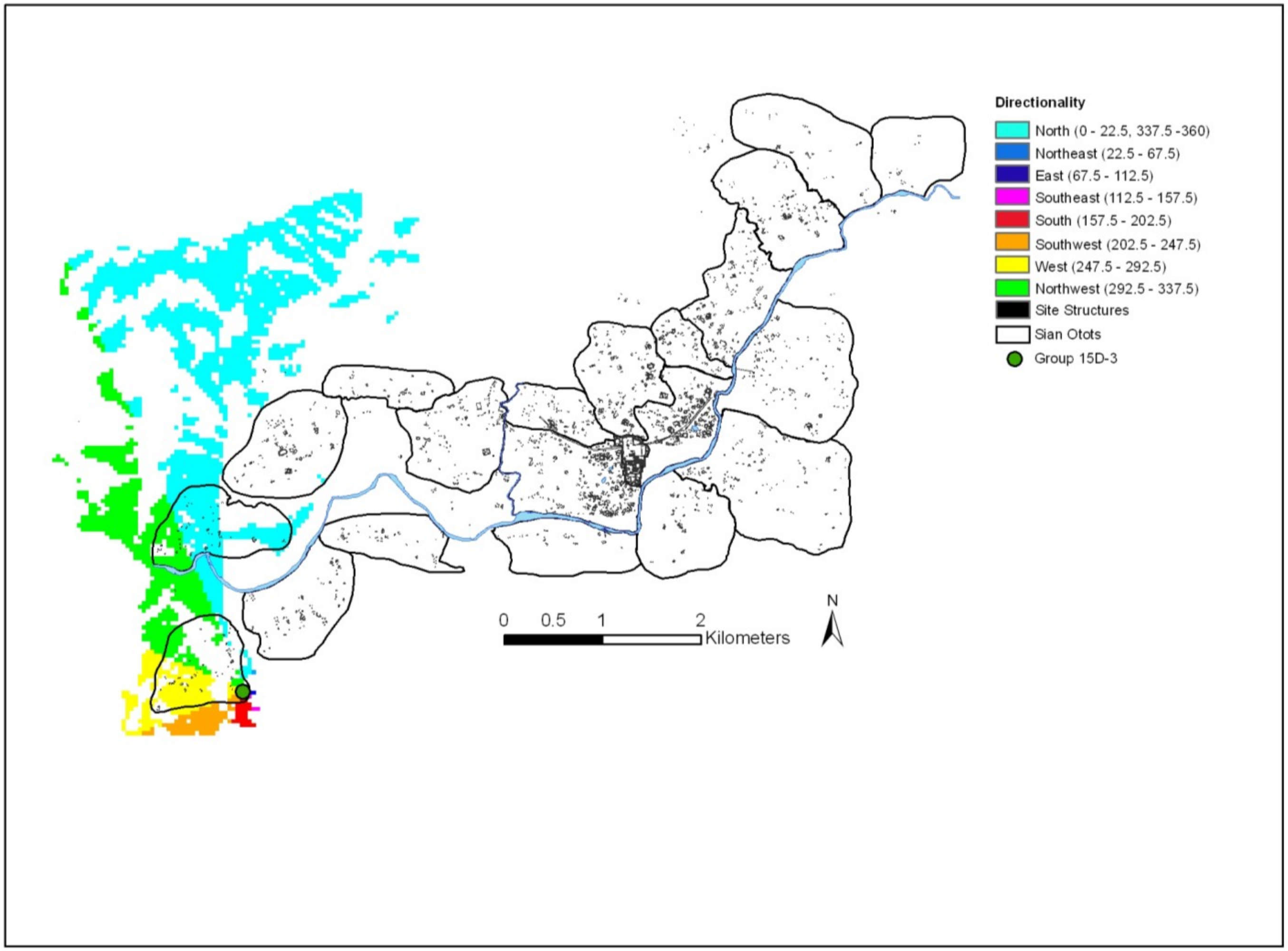


Figure 9.48: **Directionality map for Group 15D-3 in Tapescos, Copán**

Rincon del Buey

Rincon del Buey contains two type 2 sites, Groups 12D-6 and 12E-2. Group 12D-6 is in the western part of the sub-community amidst other sites; however, Group 12E-2 stands alone in the east. Of the two sites, Group 12E-2 is larger and more complex. The directionality maps indicate that both sites overlook open, high-agricultural-yield lands to the south (Figures 9.49 and 9.50). However, like Groups 10O-7 and 10P-4 in Titichon, their intra-community visual domains are distinct. Group 12D-6 visually addresses households situated within a 200-meter radius in the center of the sub-community, while Group 12E-2 targets sites up to 900 meters away—all located in the southwestern part of the *sian otot*.

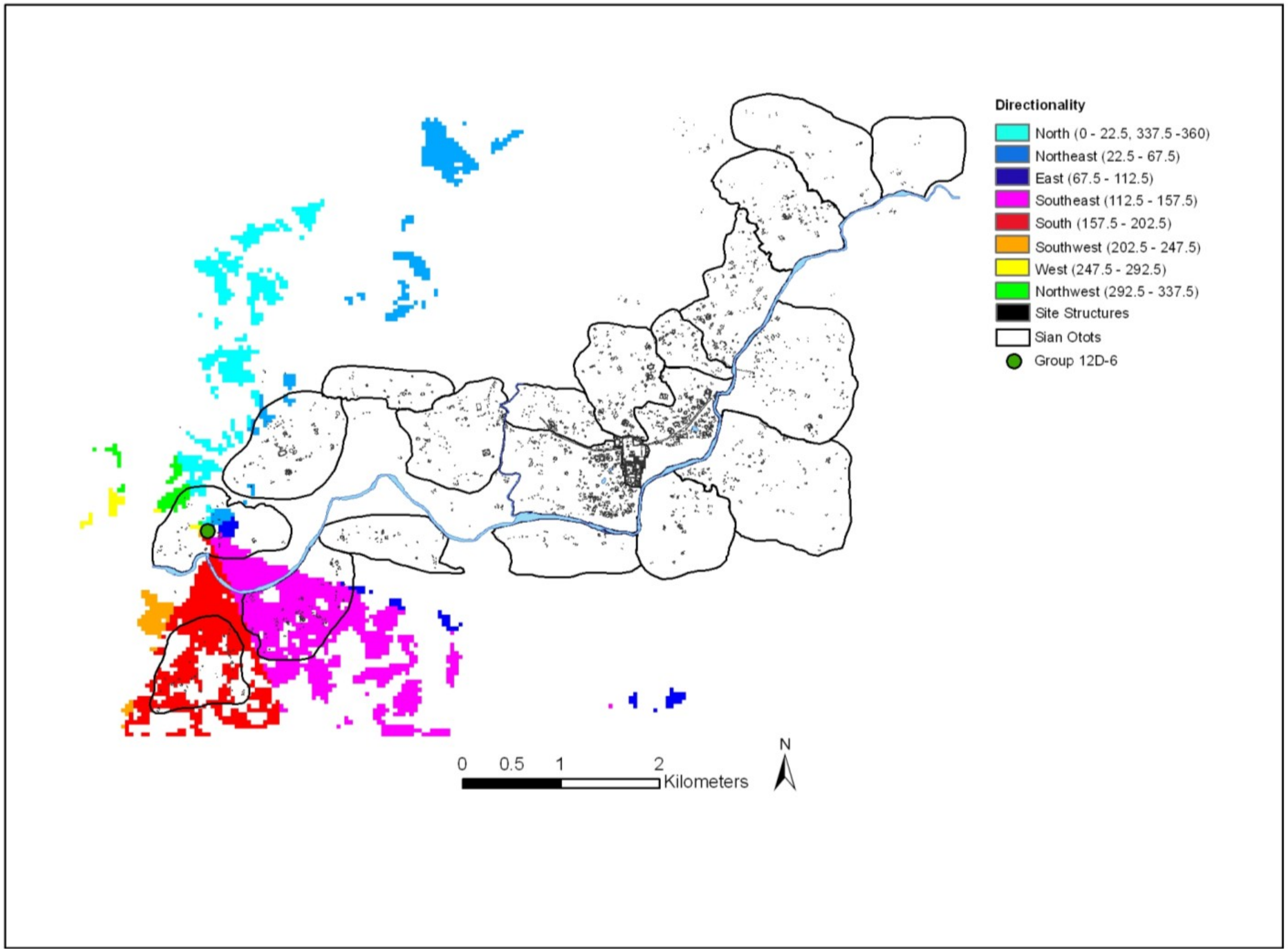


Figure 9.49: **Directionality map for Group 12D-6 in Rincon del Buey, Copán**

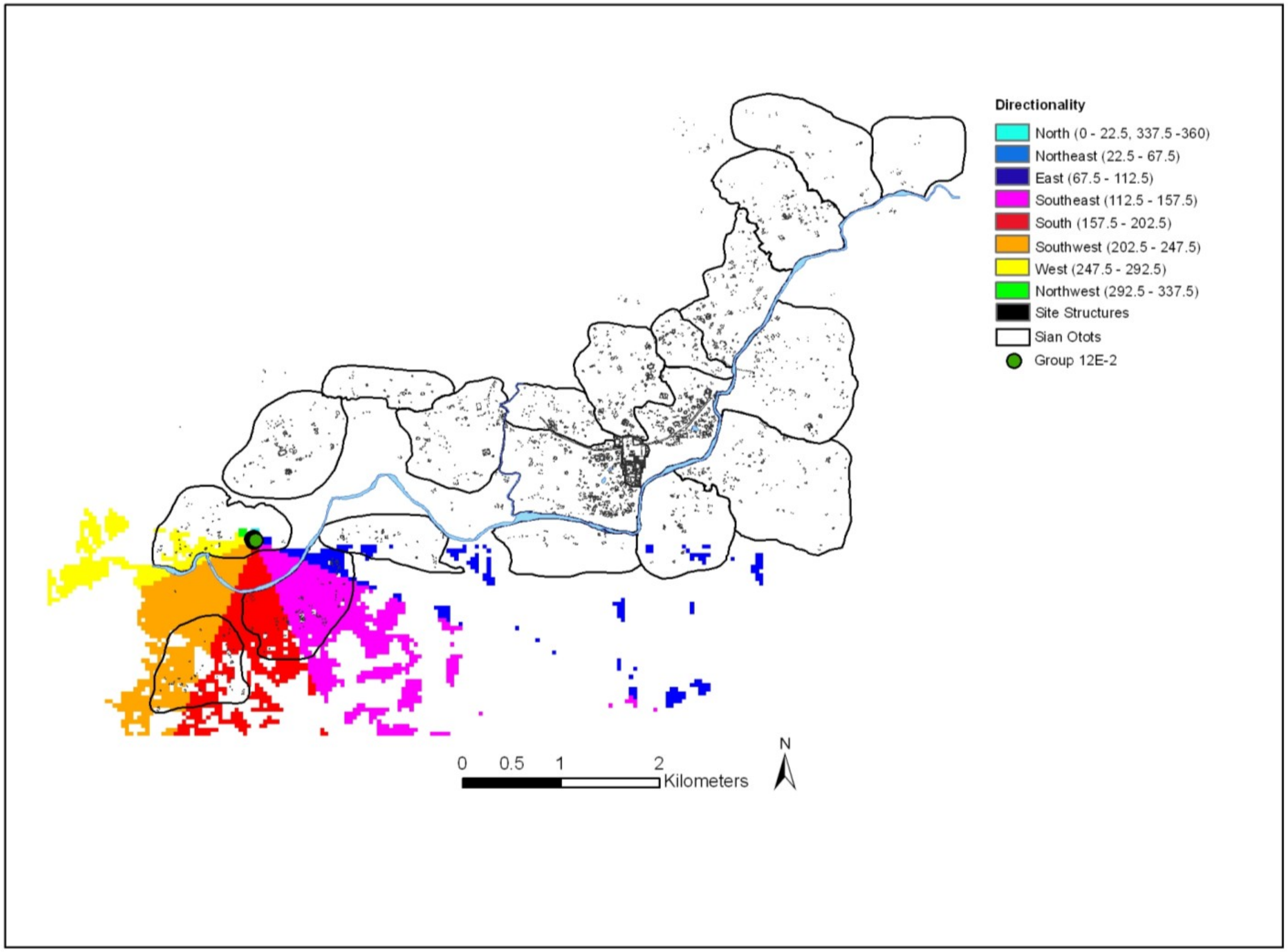


Figure 9.50: **Directionality map for Group 12E-2 in Rincon del Buey, Copán**

Ostuman

The sites in Ostuman are in an intermountain pocket (W. Fash 1983a), visually separating the area's residents from the rest of the city. The sub-community contained one type 4 site (Group 10E-6) and two type 3 sites (Groups 11E-2 and 10F-1). Although archaeologists consider Group 10E-6 to be the sub-community's dominant household, all three sites have very similar visual domains. Archaeologists have identified two of the sites 10E-6 and 11E-2 as paired; however, it is possible that 10F-1 is also part of a pairing, with Group 10F-3, a type 2 site about 165 meters to the southeast (Figure 9.51).

Figures 9.52-9.54 illustrate that the visual domains for these three groups are quite localized and actually span all directions. Visual ties appear to have been restricted to other residents of the sub-community, with a few expansive views of the mountains to the north and west.

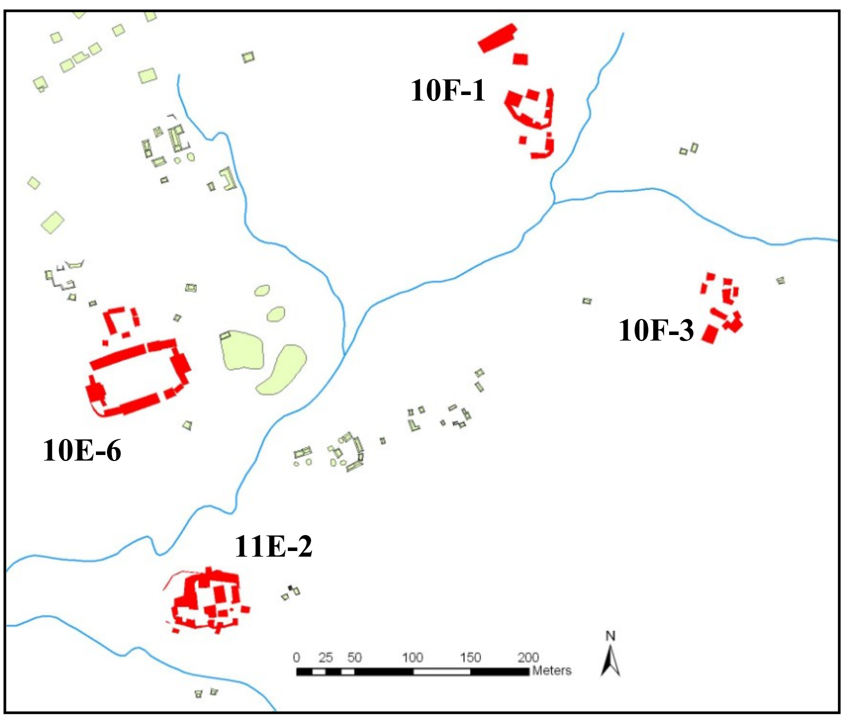


Figure 9.51: **GIS map of paired sites in Ostuman**

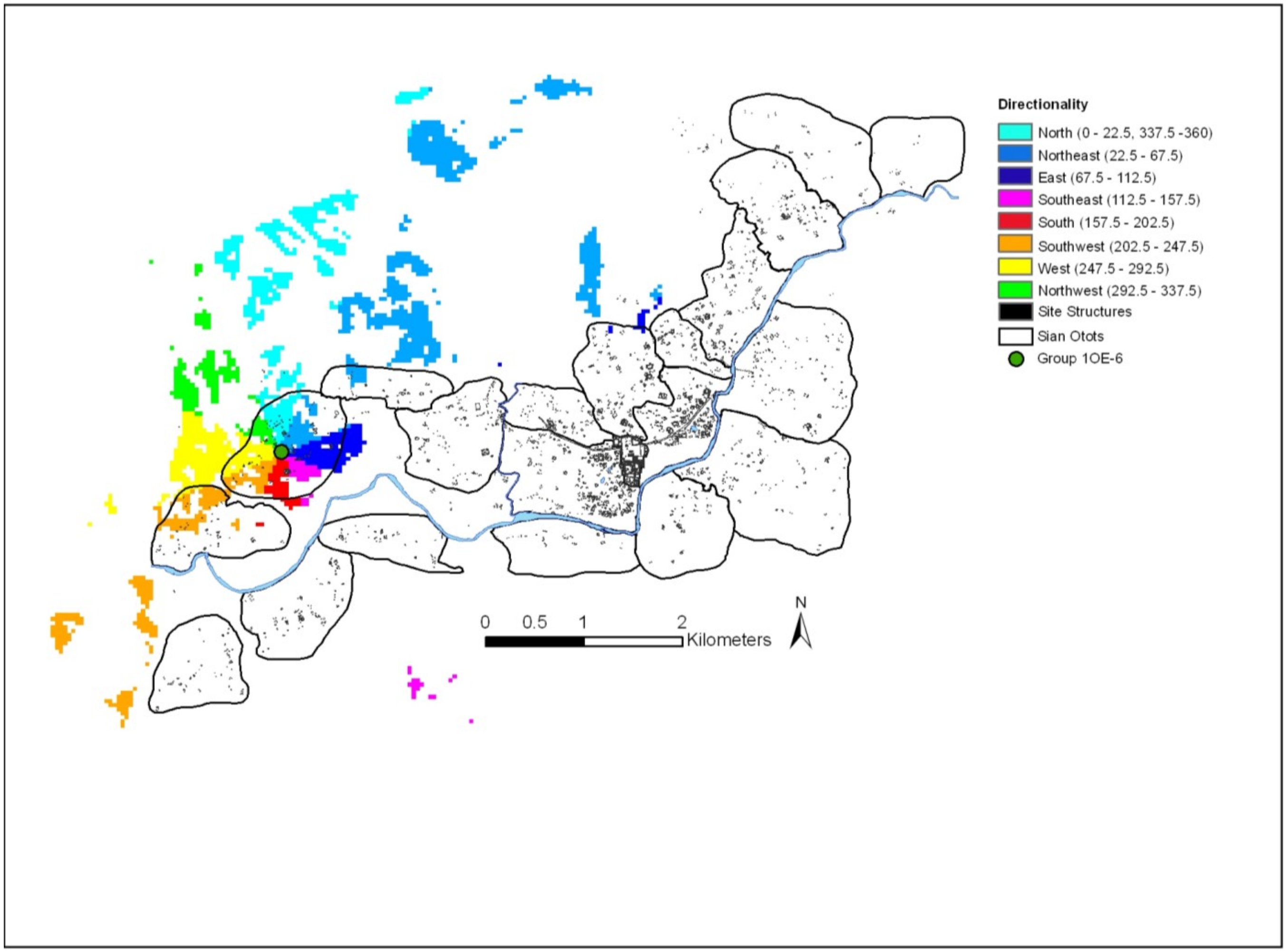


Figure 9.52: **Directionality map for Group 10E-6 in Ostuman, Copán**

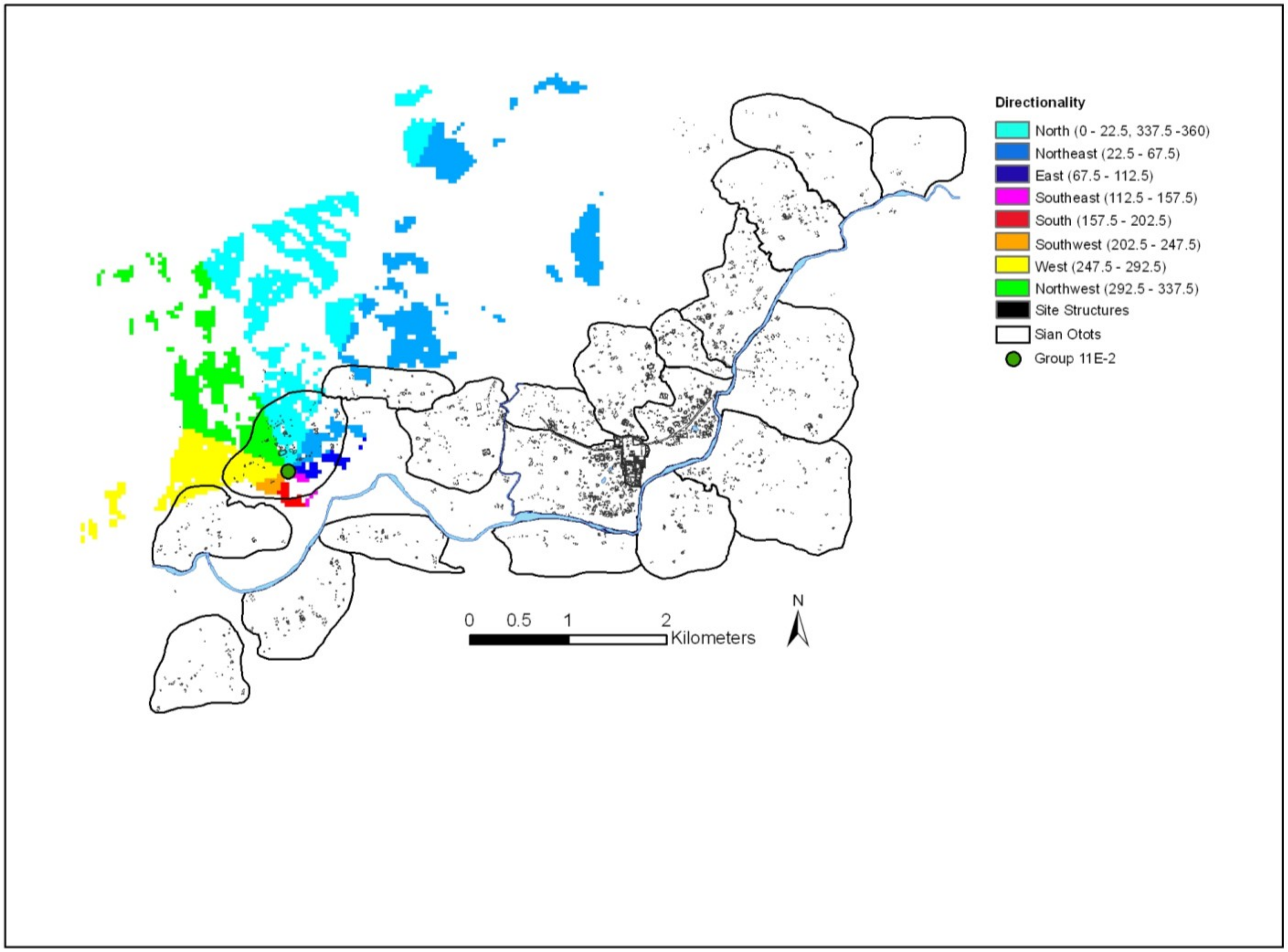


Figure 9.53: **Directionality map for Group 11E-2 in Ostuman, Copán**

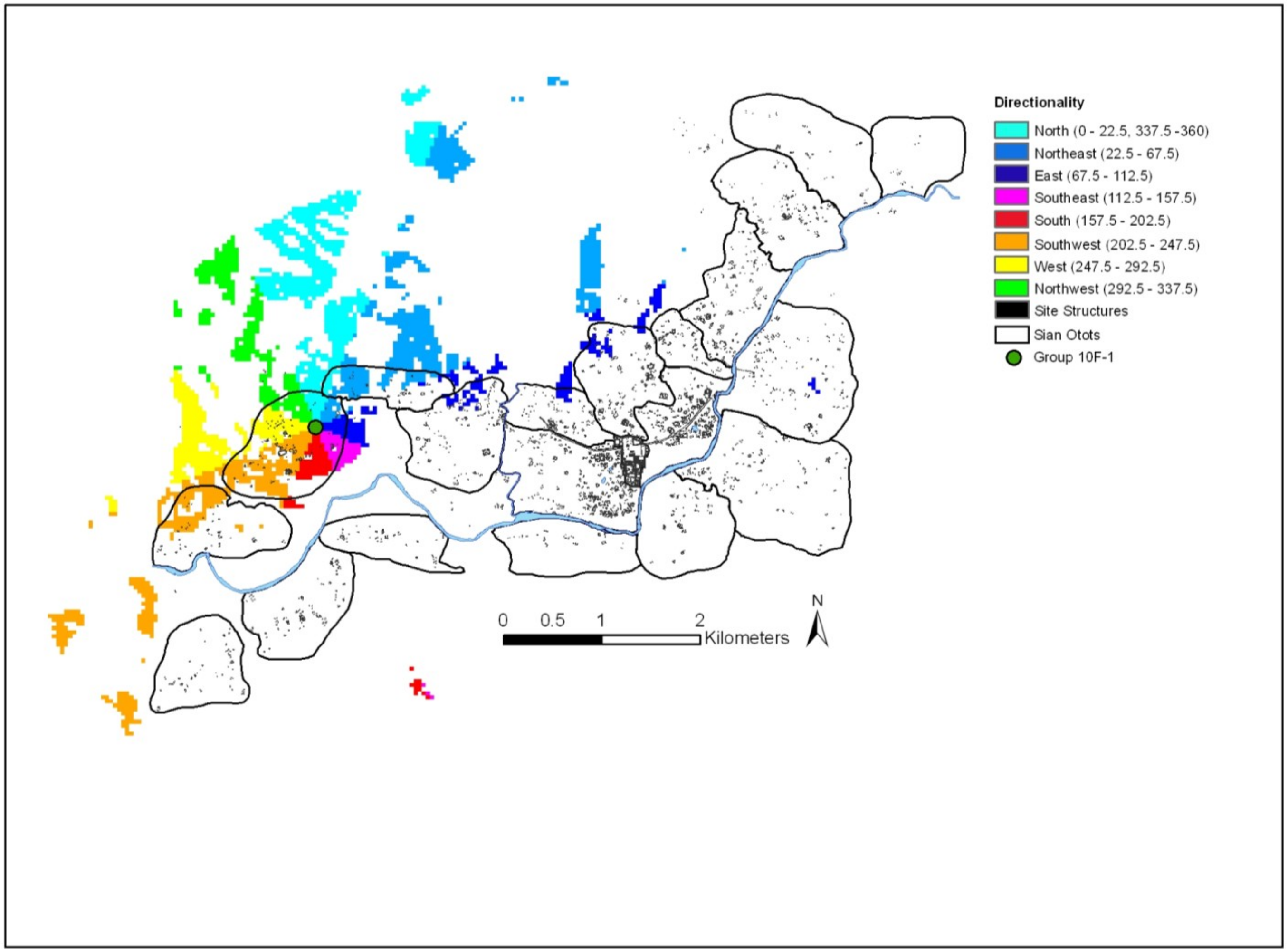


Figure 9.54: **Directionality map for Group 10F-1 in Ostuman, Copán**

Yaragua

Yaragua has one type 2 site, Group 9G-5, which is surrounded by a few scattered type 1 sites. The directionality map indicates that the most expansive views were of the relatively unoccupied mountains to the south, the southeast, and the northeast (Figure 9.55). Although most sub-community households were in view, the residents of Group 9G-5 could see almost no households in *sian otots* beyond Yaragua's boundaries.

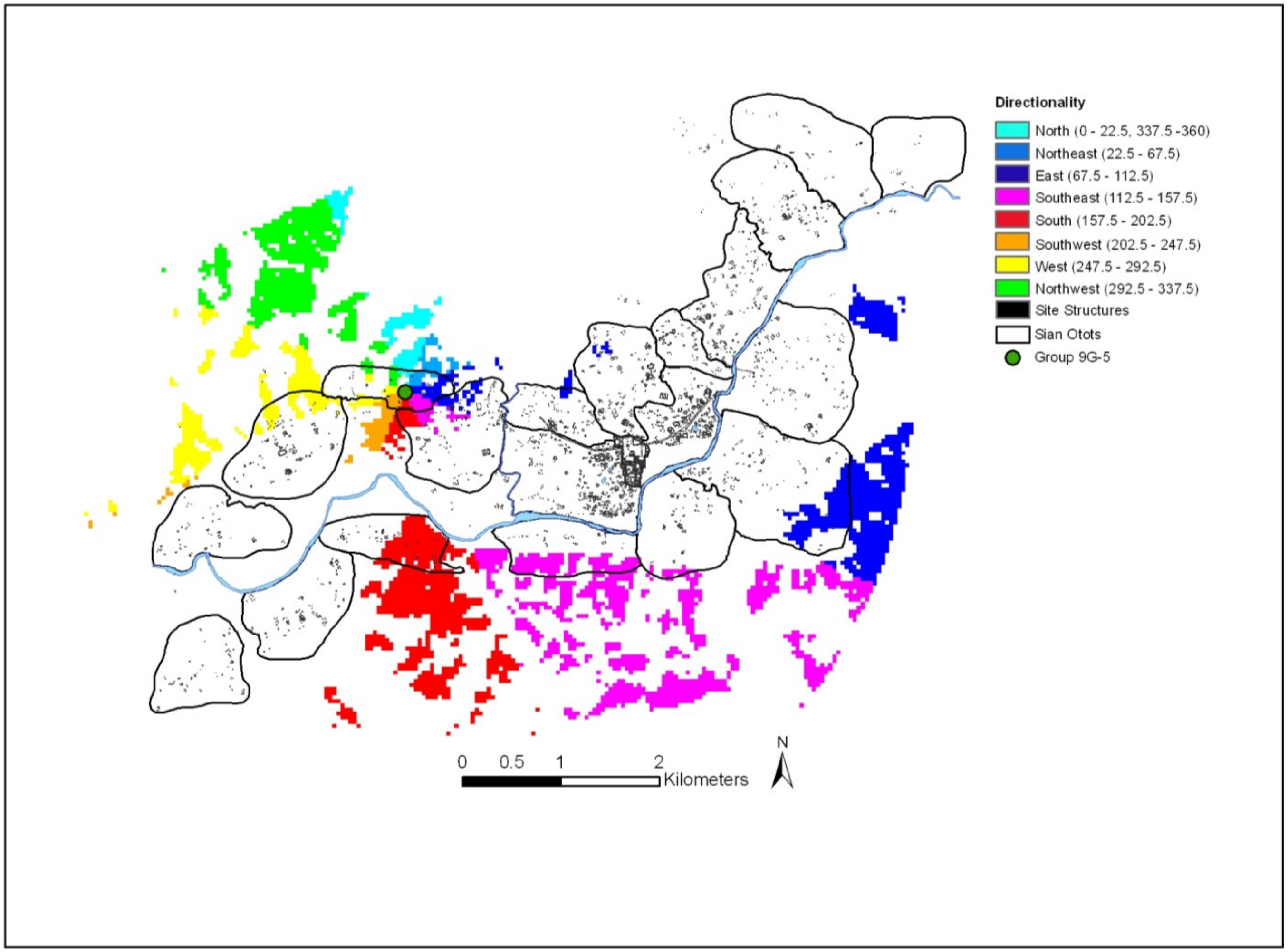


Figure 9.55: **Directionality map for Group 9G-5 in Yaragua, Copán**

Observations on Directionality of Dominant Households by Zone

Zone 2

The mid-distance visual domains for the dominant households in Las Sepulturas and El Bosque show that they generally targeted different audiences. The Las Sepulturas groups addressed people living in the eastern part of the valley and visitors entering from the east, while the El Bosque groups addressed people living in the western part of the valley and visitors entering along the western *sacbe*. The near-distance visual domains for several large type 3 and 4 sites in Las Sepulturas indicate that the largest and most elaborate of them, Group 9N-8, maintained visual ties with the entire sub-community; in contrast, the area's other elite sites targeted fewer sub-community residents. For example, people living in the northeast part of Las Sepulturas could see Group 8N-11 and people living in the southeast part could see Group 9M-23.

In El Bosque, the differences among the near-distance visual domains of the type 3 and 4 sites were less marked, yet Group 10L-18—the largest and most elaborate group in El Bosque—maintained visual ties with the entire sub-community, whereas the other large sites did not. These results suggest that despite the presence of several type 3 and 4 sites in Copán's urban *sian otots*, there was one site in each sub-community that was not only larger and more elaborate than other sites but also somewhat unique, in that it maintained visual ties with all local sub-community residents.

Zone 3

Most Zone 3 *sian otots* had at least one dominant household from which residents could see the large monumental structures of the Principal Group. Only the sub-communities of Chorro and Bolsa de Petapilla did not have large sites that were visually tied to the city's civic-ceremonial center. The majority of the dominant households in Zone 3 had unexpectedly few visual ties with other Zone 3 sites located beyond the boundaries of their own sub-communities. The two exceptions to this pattern were Group 6N-2 in Rastrojon and Group 5O-8 in Mesa de Petapilla, both of which were visible to a large number of Zone 3 sites. Interestingly, these two sites have several common traits besides their wide-spread visibility: (1) southern sites of paired residences, (2) are more isolated than their northern counterparts, (3) are more formalized than their northern counterparts, (4) somewhat restricted access, and (5) the presence of a single structure that appears to be larger than the others and possibly pyramid-shaped. The differences in their visual domains compared to other Zone 3 dominant sites, along with the similarities in their architecture and spatial arrangements, may suggest that these two sites served a different function than other dominant sites in the region. Given that Groups 6N-2 and 5O-8 established visual ties with many more sites than other supposedly dominant households in Zone 3, perhaps they functioned as shrines serving the residents of several local sub-communities (Leventhal 1979, 1981; Lucero 2007).

In general, the views from Zone 3's dominant households were toward the south, overlooking what archaeologists believe were farming communities and agricultural lands in Zone 4 (W. Fash 1983a; Leventhal 1979). The exceptions are Bolsa de Petapilla and Titoror, both located at the northeastern corner of the valley, and El Pueblo, in the west-central part of the valley. These areas were all more visually secluded, visible only to local households or to those in nearby *sian otots.* As for visual ties to the far western part of the valley (Zone 5), only three dominant households in Zone 3 were linked to far western households, and in all three cases only households in Algodonal were visible.

Zone 4

The major structures of the Acropolis were visible from all dominant households in Zone 4. Moreover, most of these same households had visual ties to the majority of sites along the northern side of the Río Copán in Zones 2 and 3. As in Zone 3, most of Zone 4's dominant households had few visual ties with other sites in the region, except for those that were relatively close by, that is, within the same sub-community. Furthermore, besides their visiblity to sites in Algodonal, their visual domains did not extend into Zone 5. Group 9P-1, the northern site of a paired residence in Titichon, was visible to many of the valley's residents, appears to have had a single structure larger than the others in the group, sat on higher ground, had fewer patios, and was more formalized than its southern counterpart. It shares these characteristics with two paired sites, Groups 6N-2 and 5O-8, in the northeastern part of the valley, suggesting that these three sites may have had similar functions—a function that set the group apart from other dominant households in the region.

Zone 5

The dominant households of Zone 5 had the smallest and most localized visual domains in the valley. In fact, unlike other zones, the Principal Group civic-ceremonial monuments were visible only from one dominant household in the region, Group 12F-3 in Algodonal. Group 12F-3's viewshed faced the off-cardinal directions (northeast and southwest), directing its focus away from other Zone 5 sites and toward the urban core and the site's major ceremonial structures. These results, combined with the fact that Algodonal was the only Zone 5 sub-community to have visual ties with people living in the eastern part of the valley, suggest that despite its location in Zone 5, perhaps its occupants belonged to a different interaction sphere than other Zone 5 inhabitants. For example, all other Zone 5 dominant households looked inward, toward their own sub-communities or toward other far western sub-communities. As for the zone's other sub-communities, Rincon del Buey's two large sites faced south and southeast overlooking Estanzuela and Tapescos. In turn, both Estanzuela and Tapescos directed their views north toward Rincon del Buey, possibly suggesting social, political, religious, or economic ties among these three communities. In contrast, Ostuman's and Yaragua's views were, for the most part, limited to households belonging to the same sub-community.

The general lack of visibility between the dominant households of Zone 5 and the Principal Group suggests that the use of visibility as a mechanism of social integration between the ruler and the western part of the valley was limited. This finding suggests that the inhabitants of this region may not have wielded substantial power. They would thus not have been a threat, and consequently not a focus of the ruler's power. On the other hand, perhaps because this area appears to have been relatively unoccupied until the Late Classic, these patterns may reflect processes of ongoing decentralization. For example, given that several scholars argue that the Late Classic was a time in which nonroyal elite were vying for power (e.g., B. Fash et al. 1992; W. Fash 1983a, 2001; Stomper 2001), that a power struggle may have resulted in decentralization and less direct control by the ruler. Consequently, placement of residential households throughout the valley may have been more haphazard and fewer households may have been constructed in the shadow of the city's major civic-ceremonial monuments. No longer would the ruler's eye constantly overlook these households and remind them of his power and connection to the supernatural (Houston et al. 2006). This phenomenon could, however, also be due to limited availability of land within the central portions of the valley due to a population boom in the Late Classic.

Summary of Directionality Results for Residential Sub-Communities

Most sub-communities at Copán housed at least one large household. In sub-communities with more than one large site, either (1) the visual domains of these large sites overlapped to address most, if not all, sub-community members or (2) each large site addressed different sub-groups within the community. If visual domains are indicative of social groupings, as some archaeologists argue, then these local-scale viewsheds may be highlighting two things (Fisher 1999; Llobera 2006): (1) the boundaries of small social groups and (2) the dominant households around which these groups were centered. The results suggest that, while in some cases the current *sian otot* boundaries are useful in understanding past local-level interaction spheres, in other cases the boundaries may need to be redefined, aggregated, or further subdivided. For example, the overlap of visual domains among multiple *sian otots* (see Zone 5 discussion on Rincon del Buey, Tapescos, and Estanzuela), with only one *sian otots* having a large, complex (type 3 or 4) site, may highlight an intermediate-level interaction sphere with a local seat of power housed at the area's largest architectural complex. This suggestion for intermediate spheres does not negate the possibility of smaller interaction spheres, such as William Fash's proposed *sian otots* (1983a, 1983b). In fact, the results may support the *sian otot* model, at least in spatial terms. Figure 9.56 illustrates the settlement pattern for waterhole groups among the contemporary Maya of Zinacanctan, Chiapas, Mexico. One possible explanation for sub-communities with one or more large sites that visually addressed different sub-groups is that these visual domains highlighted different social groups that were similar to the *snas*, or lineages, that comprise waterhole groups among the contemporary Maya of Zinacanctan (Vogt 1969). However, both of these hypotheses require further investigation.

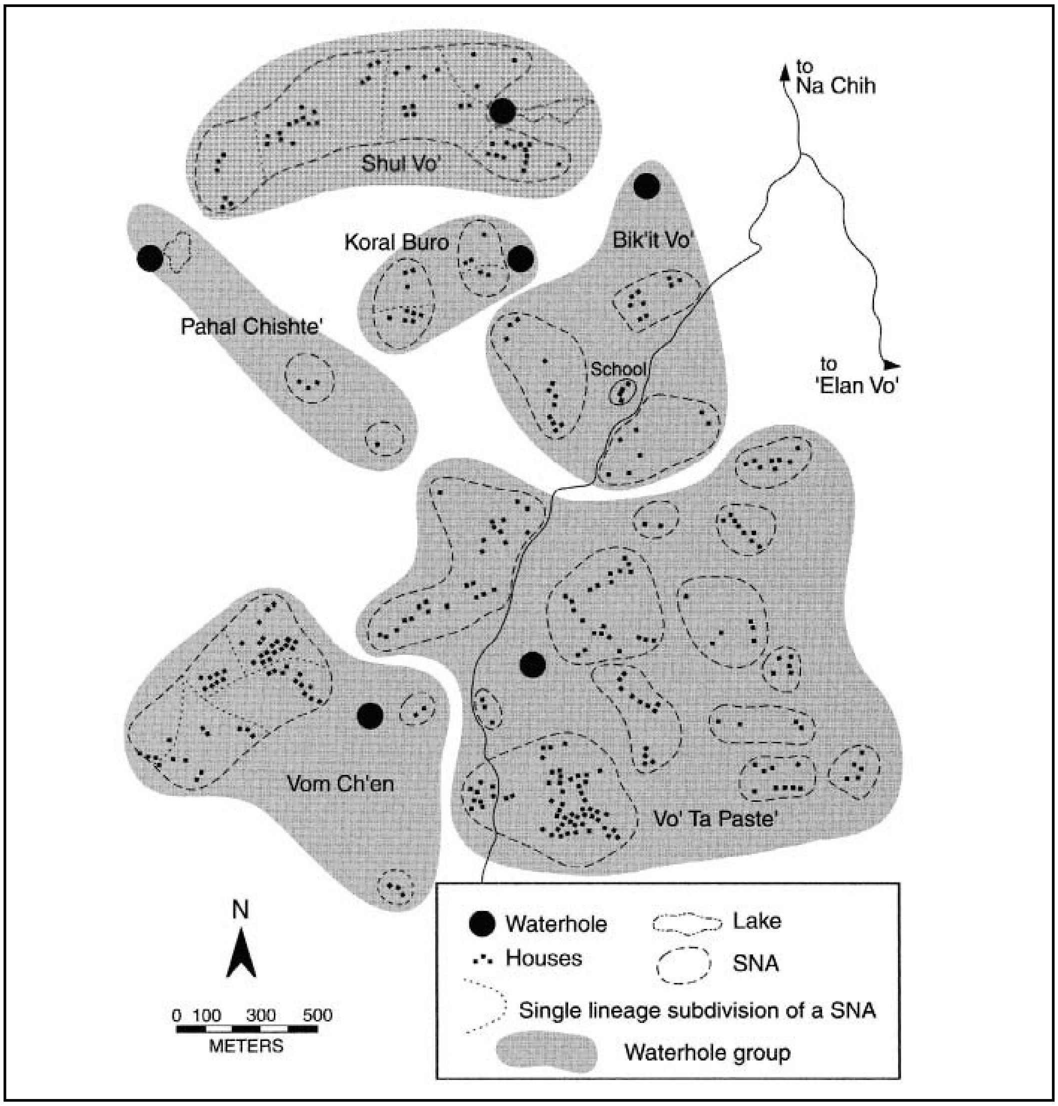


Figure 9.56: **Settlement map of waterhole groups among contemporary Maya of Zinacanctan, Chiapas, Mexico (from Davis-Salazar 2003)**

U-Shaped Cornerstone Sites

A comparison of the four cornerstone sites posited as marking the boundaries of Copán's urban core (Maca 2002) indicates the following: the visual domains of Comedero's Group 9J-5 and El Bosque's Group11K-6, both located to the west of the Principal Group, exhibit much overlap; in contrast, the visual domains of Las Sepulturas' Group 9N-8 and Chorro's Group 7M-8, both located east of the Principal Group, overlap only south of the Río Copán.

Taken together, these results suggest some complementarity in the visual domains of the western and eastern cornerstone sites, indicating that these sites were addressing different audiences. It appears that the occupants of Groups 11K-6 and 9J-5 (located west of the Principal Group) were addressing people living in the west-central part of the valley including any visitors entering the city center from the western *sacbe,* whereas Group 9N-8 targeted the eastern half of the valley. Group 7M-8 appears to be an anomaly among the U-shaped groups, addressing only a few nearby sites and those in the southeastern part of the valley. Given its low visual prominence, especially in contrast to the high visibility of Copán's other cornerstone sites, perhaps Group 7M-8's status as a boundary marker for the urban core needs to be reconsidered.

Summary and Conclusions

The overlap and directionality of visual domains provide data that help archaeologists to identify activity patterns, spatial templates, cultural groupings, and communication flow among specific locations and different groups of people (Llobera 2003, 2006). In this chapter, I analyzed the visual domains for 41 households believed to have played dominant or leading roles in sub-community dynamics (W. Fash 1983a, 1983b; Leventhal 1979). I employed directionality to investigate whether the people living at Copán constructed dominant households in locations that allowed for expansive views in specific directions that seemingly targeted particular locales or specific social groups.

The directionality data highlight several patterns indicating that visibility played an important role in communicating information to targeted audiences and structuring social interaction. These patterns suggest (1) that intra-community visibility differences reflected distinct social spheres and/or functional differences between dominant households located within the same sub-community and (2) that a subset of dominant households served as seats of power that aggregated people from several sub-communities into a larger community indicative of an intermediate-level interaction sphere. The study shows that the valley's dominant households (i.e. sites that played leading roles in local level or citywide dynamics), like the Principal Group monuments, did not exhibit any visibility patterns that were correlated to cardinality. However, two visibility patterns did emerge that inform on ancient sociopolitical dynamics in the valley.

The first pattern indicates that Copanecos did not always construct dominant groups in locations that allowed for expansive views. Instead, views often addressed local audiences, that is, people living in relatively close proximity. In sub-communities with more than one large site, the visual domains either overlapped to address most, if not all, sub-community members, or each large site addressed different sub-groups within the community. If visual domains are indicative of social groupings, as some archaeologists argue, then these local-scale viewsheds may be highlighting two things (Fisher 1999;

Llobera 2006): (1) the boundaries of small social groups and (2) the dominant households around which these groups are centered.

For example, Group 9N-8—a large and elaborately sculptured architectural complex in the urban suburb of Las Sepulturas—was visible to all sub-community residents (see Figure 8.24). In contrast, the sub-communities of other possible dominant households (type 3 and 4 sites) were visible to fewer residents, suggesting that the elite living at these sites played less dominant roles in society. Interestingly, the visibility of Sepulturas' less dominant households did not overlap; instead, they targeted distinct sub-groups within the sub-community (Figures 8.25 and 8.26). These sub-groups may reflect *snas*, and support Barbara Fash's and William Fash's (B. Fash 2005; W. Fash 1983a, 1983b, 2001) interpretations that community-level sociopolitical organization at Copán resembled the *sian otots* of modern Chorti Maya, at least in spatial terms (see Chapter 2 for a discussion of *sian otots*). In other words, the presence of multiple dominant households with distinct, non-overlapping visual domains in a sub-community may highlight different social groups that were similar to the lineages that comprise waterhole groups among the contemporary Maya of Zinacanctan (Vogt 1969).

While several hinterland sub-communities exhibit a pattern similar to that found in Las Sepulturas, in which many dominant households had localized or limited views, a few dominant households—typically part of an architectural pairing—had wide, expansive views and provide an exception to this pattern. In the late 1970s and early 1980s, archaeologists working on the Proyecto Arqueológico Copán (PAC I) observed that several sites in the valley were paired and they argued that competing yet collaborating lineages lived at these sites (W. Fash 1983a; Leventhal 1979). While the directionality data do not refute this interpretation, in combination with data on site layout and composition they lead to alternative hypotheses. Copán's paired sites exhibit a dichotomy in which one site is more isolated (few to no ancillary structures), is more formalized and compact (typically with one courtyard), exhibits restricted access, contains a single structure that appears to be larger than others and is possibly pyramid-shaped, and has greater visibility, that is, had a distinctly larger field-of-view. The question arises: *Why do these paired sites reflect such distinct differences in site layout, composition, and visibility?*

Arguably some of the differences between paired sites could signify two separate lineages; however, I believe as an aggregated set of characteristics they suggest differences in functionality, temporality, and/or ethnicity. If these paired sites represent two distinct lineages, I would expect both lineage groups to be surrounded by settlement and either to have similar visual domains or to visually target different groups, that is, the members of their own lineages. However, the two sites are markedly different from one another. I propose two alternative explanations for the paired-site phenomenon, the first focusing on functionality and the second on ethnicity.

Hypothesis 1: I posit that the formalized, isolated, and highly visible site in a paired group functioned as a community shrine. Building on Richard Leventhal's (1979, 1983) original work in the valley on ritual structures and Lisa Lucero's (2007) more recent work on the multi-vocality of shrines at the Late Classic site of Yalbac in Central Belize, I hypothesize that the high visibility of these sites created an avenue for communicating information to large audiences, in this case, ideas and beliefs about cosmology and religion. The fact that these sites are paired coincides with Wendy

Ashmore's (1991) explanation of the paired sites Groups 8L-10 and 8L-12 in Salamar, in which the northern group, 8L-10, played a more public role in society, one which the group's iconography, burial remains, and caches imply revolved around ritual. The high visibility of these sites does not in itself necessitate ritual function; however, given that they also share many other characteristics, including that they are part of an architectural pairing, exhibit a compact, formalized layout with one patio rather than several scattered patios, and have a single structure seemingly larger and taller than others in the group, and that as a pair their orientation correlates more strongly with a north-south axis than an east-west one, I contend that the hypothesis warrants testing via future excavations.

Hypothesis 2: I posit that Copán's paired sites result from an "outpost" strategy that reflects ethnic differences within the valley. Archaeological evidence indicates that the "paired grouping" phenomenon also exists outside the Copán Valley and that it reflects ethnic differences (e.g., Canuto 2004; Nakamura et al. 1991; Schortman 1993, 2001; Vleck and Fash 1986). For example, archaeologists hypothesize that in the El Paraíso valley (27 km northeast of Copán) allies or members of Copán's elite families occupied one paired site and indigenous non-Maya, specifically *Lenca*, inhabited the other. Their argument is that Maya-like sites located in non-Maya regions served as outposts located at "strategic locations near and over-looking the centers of rural indigenous populations" (Canuto and Bell 2008:16). Interestingly, the *Lenca* site has relatively open access, but relatively low visibility; in contrast, the Maya site is less accessible yet highly visible. This pattern replicates my findings for many of Copán's paired sites.

The second visibility pattern identified for Copán's sub-communities indicates that several sub-communities may have been aggregated to form intermediate-level interaction spheres. Previous research suggests that overlapping visual spheres indicate the presence of cultural groupings (Llobera 2003, 2006). At Copán, some sub-communities have several large, complex type 3 or 4 sites, while other sub-communities have only smaller, less elaborate type 1 or 2 sites. The directionality data indicate overlap in the visual domains of several sub-communities in which only one of the sub-communities has a large, complex site. These findings may highlight intermediate-level interaction spheres with a local seat of power housed at the area's largest architectural complex. This suggestion for intermediate spheres does not negate the possibility of smaller interaction spheres such as William Fash's proposed *sian otots* (1983a, 1983b).

Both the urban and hinterland data suggest that perhaps people living at dominant households played distinctly different social roles, that they exhibited an internal hierarchy reflected not only by architectural and size differences but also by their degree of visibility, and/or that there were functional differences between dominant households. Additionally, I contend that these differences may also reflect temporal, ethnic, or other differences—ideas I explore in greater detail in the next chapter.

Although more definitive explanations about the significance of these findings requires excavation, a comparison of these directionality data to the access data discussed in Chapter 6 and the visibility data discussed in Chapter 7 provides more insight into these patterns. The next chapter integrates the results from these three data sets to discuss what they may tell archaeologists about multi-scalar social interaction at ancient Copán.

Chapter 10:

Interpretations and Conclusions

This chapter integrates the access, visibility, and directionality results in order to investigate the two main questions examined in this dissertation research: (1) *Did people of different social classes experience different degrees of social connectivity?* and (2) *Did people living in different parts of the city experience different degrees of social connectivity?* The first question addresses whether people from some social classes were highly integrated with society while others were segregated, and relates these findings to issues of sociopolitical control. The second question addresses whether patterns of social connectivity were replicated across different scales of society. Both questions have important implications for understanding the nature of sociopolitical relationships at Copán and hold implications for other contexts, including but not limited to the Maya.

Using a Geographic Information System and a multi-scalar approach, I investigated four analytical scales progressing from larger to smaller scales in order to deal with temporal, spatial, and social scales in society. The scales are (1) the city as a whole (valley-wide), (2) physiographic zones, (3) urban core−hinterland, and (4) sub-communities (*sian otots*). The study used pattern recognition to generate hypotheses about relationships between social connectivity and sociopolitical organization at Copán. I identified three access and visibility patterns that provide information about the degree to which people living at different site types and in different locations in the Copán Valley were connected. (1) People living at Copán's largest and most elaborate sites, presumably the elite, had greater access to and stronger visual ties to the Principal Group than did commoners. (2) At the valley-wide scale there was an access and visual hierarchy in which elite complexes were more accessible and visually prominent than commoner households. These data suggest equal degrees of social connectivity and consequently sociopolitical control across the valley. However, the data for the urban core and hinterlands uncover variation within the valley that is masked at this largest scale of analysis. The data indicate that the accessibility and visibility of urban core elite complexes was significantly greater than that of commoner households. In contrast, hinterlands sites did not exhibit significant differences in the access and visibility of commoner and elite sites. These differences suggest greater sociopolitical control on the part of the elite in the urban core than in the hinterlands. (3) The sub-community data (an even smaller analytical scale) further refine the urban core−hinterland results. The data indicate that commoner households were more accessible and visible in the western hinterlands, while elite complexes were more accessible and visible in the eastern hinterlands. The result is a west-east spatial division in the valley marked by less sociopolitical control by the elites in the western part of the valley and greater control in the urban core and the eastern part of the valley. Collectively, these patterns provide a means to better understand how Copán's inhabitants arranged themselves on the landscape and to investigate what such arrangements say about sociopolitical structuring.

In the first part of this chapter I review the theoretical aspects of the study, focusing on the roles access and visibility play in communicating information and structuring sociopolitical dynamics. In the second part of the chapter, I summarize and correlate access and visibility patterns and discuss their implications for understanding late eighth and early ninth century sociopolitical organization at Copán. In the third part of the chapter, I reconsider the "paired site" phenomenon and then build on the patterns indentified in this study to posit several hypotheses to explain the role(s) these sites played at Copán and to chart a course for future research.

Part I: Access, Visibility, and Daily Routinization among the Ancient Maya

Archaeologists use many methods and study a wide range of material remains to investigate how ancient cultures communicated information. While these varied approaches provide essential points of reference for understanding ancient cultures, it is impossible to employ them all in a single research project. This study uses the theory of semiotics to better understand *how* and to *whom* ancient Copanecos communicated information (e.g., Gardin and Peebles 1992; Goffman 1983; Jakobson 1980; Parmentier 1987; Preucel and Bauer 2001). In this study, the *how* focuses on access and visibility and the roles they played in communicating information, based on the findings of previous research indicating that these are important mechanisms of social integration and/or segregation (Crown and Kohler 1994; Hammond and Tourtellot 1999; Hillier 1999; Hillier and Hanson 1984; Llobera 1996, 2001, 2003, 2006; Tourtellot et al. 2003; Tourtellot et al. 1999; Stuardo 2003).

Semiotics states that the ways in which people assign meaning to objects depends on a multitude of factors. These factors include not only personal traits such as gender, age, and social status, but also external factors such as object location. Location affects object meaning in several ways, and one of the most important is spatiotemporal context. Adjacency to cultural and natural features, visibility, accessibility, and cardinality all affect meaning. In phenomenological terms, as soon as people assign meaning to objects, they become signs (Casey 1987, 1993; Hall 1966). This means that for archaeologists to reconstruct the meaning(s) of ancient signs, they must take into account *who* (sender) created signs, *who* (receivers) signs targeted, and *how* messages were sent (Goffman 1983; Jakobson 1980). The *how* is essential because it helps archaeologists identify senders and receivers and provides information about the types of messages that people sent.

In recent years, archaeologists working in the Maya region—and especially at Copán—have begun to integrate top-down and bottom-up approaches to reconcile elite and commoner datasets and achieve more holistic views of ancient societies (e.g., Andrews and Fash 2005). To contribute to this ongoing effort, the *who* in my research focuses on both commoners and elites—nonroyal and royal social classes. Using the Harvard Site Typology, a five-part classification scheme that correlates social status to distinct site types at Copán, I identify the degree of social connectivity between people living at these different site types and use these data to reconstruct social relationships between commoners and elites. Following the tenets of semiotics, I developed a GIS method to quantify access and visibility in order to begin to reconstruct the *how*. This information in turn, helps me to decipher the *who*, the senders and receivers of messages.

Access and visibility served as mechanisms to transmit information about power, authority, and social status in ancient Maya society (Houston et al. 2006; Stuardo 2003; Webster 2001); therefore, they provide information on how information was conveyed and to whom that information was conveyed. David Webster (1998:40) writes that Maya builders obviously intended "to channel movement and create visual impressions of sanctity and power" through the organization of architecture. At Copán the city's rulers constructed the east and west *sacbeob* to channel people into the large, open Great Plaza, presumably for ritual events that brought together and targeted people from all walks of life. It is likely that the accessibility of these plazas sent a message of unity—"we are one"—and created a sense of community and shared identity that helped to maintain social cohesion between commoners and elite.

In contrast, the highly restricted and elevated spaces of the Acropolis most likely sent distinct messages to different groups of people. The visual prominence of massive temples constructed on elevated yet highly restricted terraces augmented the sense of intimacy and power that Copán's Acropolis conveyed. On the one hand, those who had access to the Acropolis, presumably a select group of the elite, most likely interpreted their invitation to these private spaces as a message of social unity—accessibility to these intimate royal and sacred spaces would have helped to forge social bonds between the royal elite and the lesser elite. On the other hand, the Acropolis' inaccessibility to most commoners (excepting those in service of the ruler) helped to segregate the elite from the commoners by sending messages of separateness, specialness, secrecy, and power. These messages, albeit distinctly different from the message conveyed by the openness and accessibility of the Great Plaza, also helped to facilitate social cohesion between distinct social groups. The physical segregation or separation of commoners from the elite helped to establish and maintain social inequalities at Copán. By making royal spaces relatively inaccessible and separating the elite from the commoners, the ancient Maya were replicating social structure.

As for visibility, scholars contend that the ancient Maya employed "architectural vertical zonation" in conjunction with imagery to replicate the cosmos on earth (Baudez

1994, 2000; Houston et al. 2006; Messenger 1987). Stepped architecture and imagery appear to have been linked to social status, with deities and the royal elite residing at the highest levels and lesser elite and commoners occupying successively lower levels (Reents-Budet 2001). Figure 10.1 shows a pictorial scene from a Late Classic cylinder vessel that depicts a ruler seated high on his throne conferring with two scribes, who are positioned lower, while above the ruler are glyphs placing supernatural deities on the highest level. Such images highlight the importance of verticality in relation to cosmology among the ancient Maya. I contend that this notion of verticality was also linked to visibility in ancient Maya society (Hammond and Tourtellot 1999; Houston et al. 2006; Tourtellot et al. 1999).

Figure 10.1: **Scene from Late Classic cylinder vessel illustrating stepped imagery (from www.famsi.org/research/kerr/palace.html)**

Archaeological, epigraphic, and ethnographic studies suggest that the ancient Maya assigned visibility to high-status individuals (Houston et al. 2006:173). Individuals who were all-seeing were consequently all-knowing (Houston et al. 2006), and in order to appear as all-seeing, I argue, such individuals had to be highly visible (Leone 1984). Both the height and mass of ancient Maya temples attest to the importance of visibility. The practice of erecting massive monuments that towered over their surroundings dates back to Preclassic period sites such as El Mirador and Nakbe and extends into the Postclassic (Coe 2005; Sabloff 1997). Historical precedence and social memory would have ingrained the association between verticality/visibility and status/power in the minds of Late Classic Maya.

Along these lines, most Maya scholars assume that monumental architecture was highly visible, and in fact, the viewshed data from this dissertation research support this assumption, indicating that 76% of late eighth and early ninth century households in the Copán Valley could see the city's major civic-ceremonial center, the Principal Group. These results, albeit not surprising, offer the first quantitative measurement supporting the assumption that Copán's civic-ceremonial precinct was highly visible. In fact, it was visible to 30% more Copanecos than type 4 sites, the next most visible site type (see Table 7.2).

While quantifying the visibility of the city's monumental architecture is important, this research seeks to move beyond the Principal Group. It asks the question: *Is higher visibility correlated to higher social status at all levels of ancient Maya society?* To address this question, I used the GIS to measure the visual prominence and visual connectedness of Copán's four residential site types (1−4) and identify whether or not a visual hierarchy existed in the residential architecture. Visual prominence measures a site type's overall visibility and provides information on the overall communicative potential of specific site types, while visual connectedness measures visual connectivity between specific site types and provides information on communication links between people living at specific site types.

Given the link between verticality, visibility, and status among the ancient Maya royalty, it was expected that higher-status residences would be more visible than lower-status residences. Higher visibility is believed not only to have connoted power, but also to have served as a mechanism of sociopolitical control and social integration. The association between all-seeing and all-knowing suggests that highly visible households were able to watch over large numbers of people and influence, if not control, their behavior (Maples 2004). Visibility functions as an integrative cultural mechanism in two important ways. High visibility can work in a coercive manner because people who feel as if they are being watched often act differently than those who do not (Foucault 1979). However, high visibility can also help to create social cohesion by visually connecting groups, establishing people as neighbors or members of the same group (Hammond and Tourtellot 1999; Llobera 2000, 2006; Tourtellot et al. 1999). Thus, while visual prominence sends messages of power and authority, visual connectedness sends messages of unity and cohesion, and these two aspects of visibility work together to help create and maintain social order.

While many scholars argue that the ancient Maya employed access and visibility as mechanisms of cultural integration and/or segregation, very few studies actually quantify access and none quantify visibility. Additionally, such studies are limited to monuments or elite architectural complexes and do not take into account the more mundane everyday architecture of commoners. Moreover, they focus explicitly on the built environment, and as a consequence they fail to take into account the natural landscape. Wendy Ashmore (2004:169) writes that "Maya landscapes and the traces of settlement on them are inseparable, and neither can be considered without the other." Consequently, I view Maya sites not simply as groupings of anthropological features but as a combination of the built environment and the natural landscape, referred to by the contemporary Maya as the *kahkab* (Marcus 2000), and incorporate both the built environment and natural landscape in measures of access and visibility.

It is through daily routinization that messages of social order are sent, and the accessibility or inaccessibility and the visibility or invisibility of places play key roles in how and to whom messages were sent. This research seeks to improve upon previous studies of access and visibility in the Maya region in three ways: (1) it uses GIS to quantify access and visibility patterns, (2) it employs a landscape approach to integrate the built environment and the natural landscape, and (3) it measures access and visibility at multiple scales to identify similarities and differences in social connectivity at different levels of society (sub-community, urban core, hinterlands, and valley-wide), and uses these findings to investigate heterogeneity in sociopolitical organization.

Reconstructing Social Connectivity from Access and Visibility Results

The next section summarizes and integrates the access and visibility patterns for the four analytical scales and discusses their implications for addressing the two main research questions in this dissertation research: (1) *Did people of different social classes experience different degrees of social connectivity?* and (2) *Did people living in different parts of the city experience different degrees of social connectivity?*

Valley-Wide Patterns

The valley-wide access results indicate that Copán's residents positioned themselves in the landscape to make some site types more accessible than others. The city's layout created an access hierarchy that made higher-status sites more accessible than lower-status sites. The Great Plaza had the highest degree of accessibility, indicating that the city's residents organized infrastructure to facilitate pedestrian movement, irrespective of social class, toward this open, public space (see Table 6.1).

As for residential sites, people living at type 4 sites were the most accessible. In other words, they had the highest degree of social connectivity of any social group except the ruler and other individuals living in the Royal Courtyard. The elite living at type 3 sites had the second highest degree of social connectivity. While commoners living at type 2 and type 1 sites were the least connected to society (i.e., to all other site types), type 1 sites had much lower integration values than type 2 sites.

The elite living at type 3 and 4 sites appear to have positioned themselves at strategic locations that afforded them a very high degree of social connectivity, including providing them the greatest access to the ruler, other members of the royal court, and the ritual ceremonies performed in the city center. Previous studies show that people living at highly integrated locations can more easily exercise their authority as a result of greater access to both people and resources (Hillier 1999; Hillier et al. 1993; Hillier and Hanson 1984). Therefore, the access pattern suggests that people living at type 3 and type 4 sites positioned themselves at locations in the valley that would help centralize their power.

Although the valley-wide access results seemingly replicate Copán's social hierarchy, the integration values for type 2 sites (presumably commoner households) and type 3 sites were more similar than those for type 3 and 4 sites (presumably elite complexes). These results provide some evidence that the Harvard Typology's classification of type 2 and 3 sites has some problems, at least when addressing questions about social connectivity. The findings do not necessarily invalidate the Harvard Typology's assumption that elites occupied both type 3 and 4 sites; however, they do suggest (1) that people living at type 4 sites appear to have played roles requiring that they be more socially connected to society as a whole and (2) that some type 2 and/or type 3 sites may be misclassified—a pattern that is also identified at the other scales of analysis.

The valley-wide visibility pattern, albeit similar to the access results, is slightly different. The visibility of Copán's site types replicates the social hierarchy inasmuch as the city's only type 5 site, the Principal Group, is by the far the most visually prominent location in the valley. The results indicate that although it was important for Copán's 16th ruler to appear all-seeing to society as a whole, he seems to have disproportionately targeted the city's elite, people living at type 3 and 4 sites, as receivers of the visual messages of his power, and/or more often established visual links among himself, his royal court, and other elite in order to help maintain social cohesion among Copán's dominant class(es).The viewsheds indicate that 87.5% of elite lived in sight of the Principal Group, while only 59.5% of commoners did (Figures 7.1 and 7.2).

While type 4 sites are the next most visually prominent site type, and type 1 sites are the least visually prominent, the expectation that type 3 sites would have higher visual prominence than type 2 sites was not realized. The valley-wide results indicate that the visibility of type 2 and 3 sites is indistinguishable, and like the access results suggest either more similarity between type 2 and 3 sites (presumably occupied by people from different social classes) than between type 3 and 4 sites (both presumed to be elite site types) (seeTable 7.2), or a problem with the Harvard Site Typology.

In sum, the valley-wide findings indicate that as accessibility (i.e., social connectivity) increased, social status increased. The visibility results, while not so exact, exhibit a similar pattern, and the lack of a definitive visual hierarchy is most likely due to the misclassification of some sites. To reiterate, the high visibility of the Principal Group and type 4 sites may be linked to the Maya belief that people who are all-seeing are all-knowing (i.e., via surveillance) and thus may have given the occupants of these sites an aura of power (Houston et al. 2006). The results support the assumption that access and visibility—at least at the valley-wide scale—served as mechanisms to help create and maintain distinct social categories.

Urban Core−Hinterland Patterns

The access and visibility results indicate that people living in the urban core were more socially connected, or integrated, to society as a whole than people living in the hinterlands. The access patterns indicate greater social differentiation expressed through differential access to specific site types within the urban core.

Along these lines, in the urban core there existed a visual hierarchy among residential site types that replicated Copán's social hierarchy, with type 4 sites being the most visible, followed by type 3, type 2 and finally type 1 sites. The exact opposite appears in the hinterlands. Type 1 sites were the most visually prominent, followed by type 2, type 3, and finally type 4 sites. The hinterland pattern is probably due in great part to the greater numbers of type 1 and 2 sites in relation to the number of type 3 and 4 sites, as well as the large area of the hinterlands, approximately 21-square kilometers. In comparison, the urban core had a larger percentage of type 3 and 4 sites and encompassed a much smaller spatial extent, approximately 3-square kilometers. Although all of Copán's elite probably used the visibility of their households to differentiate themselves from commoners, the fact that people living in the hinterlands had fewer visual connections to type 3 and 4 sites may indicate two things: (1) less social inequality and/or social tension in the hinterlands, and thus less need to send visual messages of power and class distinction; and (2) a lesser degree of sociopolitical control in the hinterlands—people living in the hinterlands may have felt less "watched over" than people living in the urban core.

Jointly, the access and visibility data indicate greater sociopolitical control in the form of channeling movement toward and creating stronger visual ties to elite sites in the urban core than in the hinterlands. Archaeological excavation and test units indicate that the urban core is the oldest and most continuously occupied part of the valley (W. Fash 1983a, 2001; Webster 2005; Webster et al. 2000), and the results therefore reflect a pattern of growth and development in which there was less social control in newer areas of the city than in older areas. They provide new information on core−periphery relations and the effect of growth and development on social connectivity and sociopolitical control. Additionally, they offer a line of evidence pointing to the presence of at least two interaction spheres in the valley. The physiographic zone data refine the urban core-hinterland pattern, identifying the presence of an east-west spatial division in which people living in the western part of the valley experienced less sociopolitical control than people living in the urban core and eastern part of the valley.

Physiographic Zone Patterns

The physiographic zone results indicate that a wide range of both ecological and social variables were responsible for Late Classic access and visibility patterns in the Copán valley. Factors such as site type, settlement density, building height, landform, slope, elevation, and settlement density worked together to increase or decrease accessibility and visibility. Not unexpected, people living in Zone 2, the city's most densely occupied area, had access values suggesting that they were highly integrated with society as a whole. In marked contrast, people living in Zone 5, an ecologically diverse area in the western part of the valley, were by far the most segregated or least accessible members of society. The cost to travel from Zone 5 sites to other parts of the valley was two to three times more than it was for any other physiographic zone (see Table 6.3). In a similar vein, the visibility values indicate that Zone 5 sites had weak visual ties to the rest of the valley. Sites located in Zone 5 were 30%−60% less visible than sites in other parts of the valley. The extremely low accessibility and visibility of Zone 5 sites indicates a low degree of social connectivity, which in turn signifies greater isolation and segregation for people living in the western part of the valley.

On the one hand, the low accessibility and visibility of sites in Zone 5 may reflect less sociopolitical control by Copán's ruling class in this region. One explanation for this phenomenon may be that as Copán's ruler and elite experienced more difficulties in the later years of the Late Classic, they may have had less control over where people lived. Archaeological evidence suggests a late occupation for this region, and thus the zone's relative inaccessibility may reflect a new freedom to build residences at greater distances from the urban core. Such freedom, in turn, may reflect decentralizing tendencies and power loss for Copán's ruling authority, supporting arguments that Copán's final three dynastic rules (Rulers 14−16) faced environmental and sociopolitical stresses that forced them to share power with nonroyal elite (B. Fash et al. 1992; W. Fash 2001; Webster 2002). On the other hand, these low values may simply be due to rapid Late Classic population growth and overcrowding in the central and eastern parts of the valley, which may have necessitated the occupation of new and more distant parts of the valley. Thus, while late eighth and early ninth century Copanecos may have desired to live near the Principal Group where they would have been less socially isolated though under more sociopolitical control, demographic circumstances may have forced them to locate in the less attractive western part of the valley, where environmental factors decreased accessibility and visibility and marginalized them from the rest of society.

In all but Zone 3, the accessibility of site types replicates Copán's social hierarchy, that is, the Principal Group was the most accessible location and type 4 sites were the most accessible residential site type, followed by type 3, type 2, and type 1 sites. In Zone 3, the foothills north of the river, type 2 sites are slightly more accessible than type 3 sites (see Table 6.8). This exception offers a third line of evidence supporting my assertion that some type 2 and 3 sites are misclassified. Interestingly, it is in Zone 3 that several type 2 sites are considered "dominant" households and initial test excavations that have been carried out at some of these type 2 sites reveal that some type 3 characteristics, such as dressed stone, corbel vaults, and sculpture (W. Fash 1983a; Freter 2004; Webster et al. 2000). As a consequence, I contend that if archaeologists reclassify the valley's "dominant" type 2 sites as type 3 sites, then it will become apparent that type 3 sites are, in actuality, more accessible than type 2 sites in Zone 3.

Turning to the visibility data for Copán's physiographic zones, the Principal Group is the most visible location in the valley, and commoner households (types 1 and 2) are the least visible site types; however, unexpectedly, type 3 sites are more visible than type 4 sites. Taken by themselves, these data seem invalid because they do not replicate either the valley-wide or the urban core−hinterland results. When the data are examined at an even smaller scale (the sub-community), though, a distinct pattern emerges that supports these findings. As a result, the usefulness of multi-scalar research is underscored: when we evaluate data at smaller analytical scales, spatial variation, often muted at larger scales, is unmasked.

Sub-Community Patterns

In the early 1980s, William Fash (1983a, 1983b) observed that site distribution at Copán resembled settlement patterns among the Chorti Maya—a modern Maya group living in Guatemala and northwestern Honduras. He used the *sian otot* communities of the modern Chorti Maya as an analogy for understanding Late Classic sociopolitical organization at Copán (Freter 2004; Vogt 1969, 1983; Wisdom 1940) (for full discussion of the *sian otot* model, see Chapter 2). The fourth and smallest analytical scale of my research measured access and visibility for these sub-communities.

The objective was to identify and compare sub-communities with low degrees and high degrees of social connectivity to investigate similarities and differences in sociopolitical organization at smaller and larger scales of interaction. These data were collected in order to contribute to the ongoing debate as to whether or not sociopolitical organization was replicated at smaller and larger levels within Copaneco society (W. Fash 1983a, 1983b; Maca 2009). The sub-community analysis provides data that support and refine the spatial patterns identified at the valley-wide, urban core−hinterlands, and physiographic zone scales. In particular, the results reveal variation masked at the larger analytical scales and support the conclusion that three intermediate-level interaction spheres based on differential degrees of sociopolitical control existed at Late Classic Copán.

Intermediate-Level Interaction Spheres

The sub-community data support an east-west division in the Copán Valley, with (1) greater social connectivity and (2) greater sociopolitical control in eastern sub-communities. When these data are integrated with the urban core data, they suggest that three intermediate-level interaction spheres existed at Copán in the late eighth and early ninth centuries (Figure 10.2).

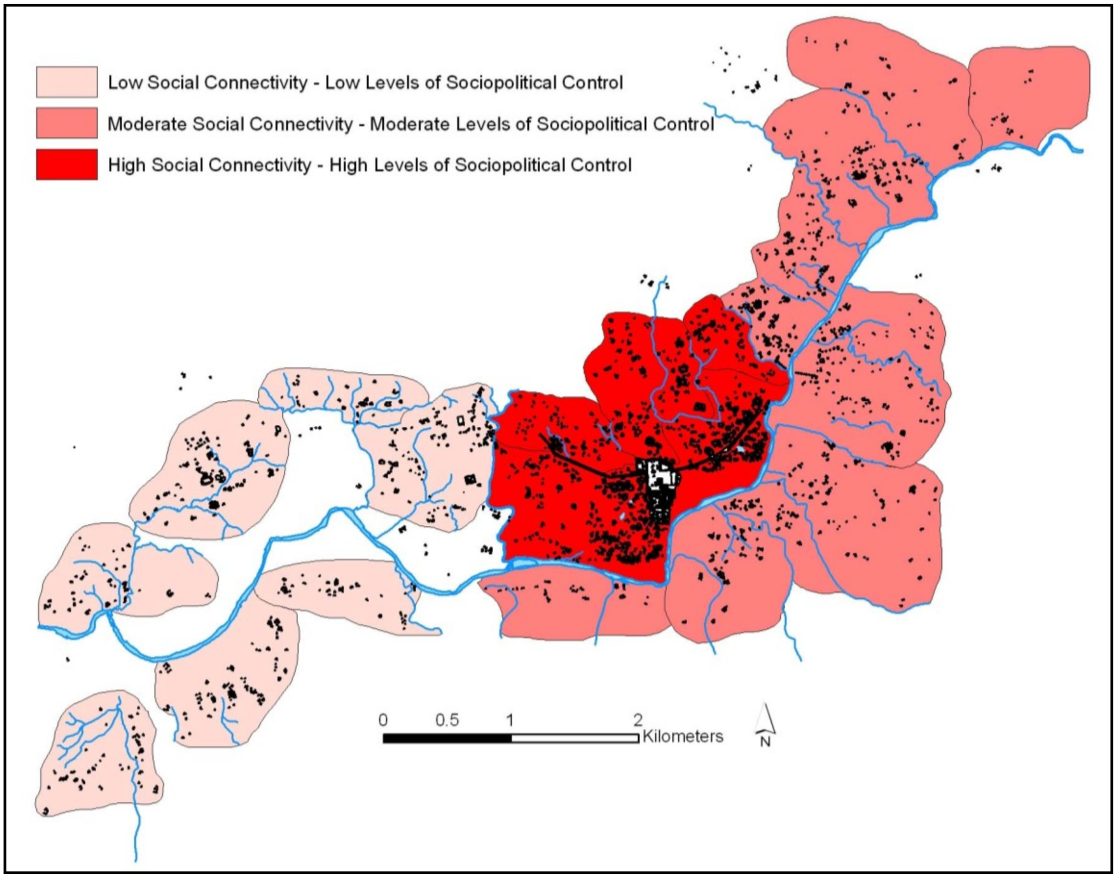


Figure 10.2: **Three interaction spheres at Copán as defined by access and visibility patterns**

Both the access and visibility data indicate that people living in eastern and central sub-communities were more integrated with society than inhabitants of western sub-communities. People living in western sub-communities exhibited the lowest degrees of social connectivity in the valley, both in the fact that the cost to travel to these areas was very high and that they had the weakest visual ties to the rest of the valley. While the inhabitants of eastern sub-communities had greater access to and stronger visual ties with more members of society than people in the western part of the valley, people living in the central part of the valley, the urban core, had the highest degrees of social connectivity. However, there may have been an advantage to the social isolation of the western sub-communities—less sociopolitical control and less class segregation on the part of the royalty and other elite.

The access and visibility data also show that people residing in western sub-communities experienced the lowest degree of sociopolitical control, the occupants of eastern sub-communities felt a moderate degree of sociopolitical control, and urban core residents experienced the greatest degree of sociopolitical control and class segregation. Research suggests that large differences in access and visibility values reflect greater sociopolitical control and segregation (Hillier 1996, 1999; Hillier and Hanson 1984). In this case, large differences in the access and visibility of distinct site types signify class segregation between commoners and elites. Large differences in access reflect greater control over pedestrian movement, while large differences in visibility signify greater control via visual messages of power and surveillance (Foucault 1979; Houston et al. 2006; Leone 1984).

Small differences in the access and visibility values for different site types in western sub-communities indicate a low degree of sociopolitical control and class segregation. Slightly larger differences in the access and visibility values for different site types in eastern sub-communities signify a moderate degree of sociopolitical control and class segregation, and the large differences in access and visibility values for different site types in the urban core reflect a high degree of sociopolitical control and class segregation. At the same time, urban core residents were channeled toward and maintained stronger visual ties with elite sites.

With respect to sociopolitical ties between royalty and the rest of society, the access and visibility data indicate that in the late eighth and early ninth centuries, Copán's 16th

ruler differentially targeted elite and commoners. The access data show that the people living at type 3 and 4 sites had the highest degree of access to the Principal Group, including the Royal Courtyard, which provided them with the greatest access to the ruler and members of the royal family as well as the ritual ceremonies performed in the city center. Such results may indicate (1) that Ruler 16 desired greater sociopolitical control over urban elite than urban commoners and/or (2) that urban elite were part of the royal court, as scribes, priests, warriors, administrators, or wealthy merchants, and thus required greater access to the ruler (Inomata and Houston 2001; Webster 2001). The strong visual ties between the ruler and urban elite provide additional support for these explanations.

While the inhabitants of eastern sub-communities did not experience as large a degree of sociopolitical control and class segregation as urban core residents, they had greater access and stronger visual ties to elite complexes than to commoner households. In contrast, the occupants of western sub-communities had equal access to both elite and commoner sites; in other words, unlike in the central and eastern parts of the valley, they were not channeled to elite complexes. Moreover, people residing in western sub-communities maintained stronger visual ties to commoner households than to elite households. Furthermore, several sub-communities lacked visual ties to the city's main civic-ceremonial group, suggesting that they escaped ruler surveillance; in other words, because they did not live in the shadows of the Principal Group monuments, they did not feel the same sense of being "watched over" as people living in the central and eastern parts of the valley (Houston et al. 2006; Leone 1984).

Jointly, the access and visibility data point to the presence of three intermediate-level interaction spheres in the valley. Figure 10.2 illustrates a spatial division of the western, eastern, and urban core interaction spheres. People living in the western part of the valley were less socially connected, experienced lower levels of direct sociopolitical control, and were subjected to minimal class segregation compared to people in other parts of the valley. The occupants of eastern sub-communities experienced moderate degrees of social connectivity, sociopolitical control, and class segregation. While urban core residents had the strongest social connectivity, they experienced the greatest degree of sociopolitical control and class segregation. These findings reveal some of the underlying complexities of sociopolitical organization that are masked at both large analytical scales (valley-wide) and micro-level scales (household or architectural complex) and thus provide scholars with new information on intermediate-level interaction spheres.

Part II: New Directions for Future Research

While Copán's long history of excavation and research provides a wealth of information on ancient sociopolitical dynamics, recent archaeological evidence questions some commonly accepted interpretations of the city's sociopolitical organization in the late eighth and early ninth centuries (e.g., Canuto 2004; Maca 2002; Manahan 2003, 2004; Manahan and Canuto 2009; Plank 2003, 2004). This section integrates this study's data with information from previous research to address some of the ongoing debates about Late Classic sociopolitical organization at Copán. I focus on two topics: (1) problems with the Harvard Site Typology and (2) the paired site phenomenon. I begin with a synopsis of current debates about sociopolitical organization, follow with an in-depth review of the sub-community data, and then integrate the results from the first part of the chapter to suggest new directions for future research.

Debates on Copán's Sociopolitical Organization

Recent studies suggest that ancient Copán's population, long considered homogeneously Maya, was multiethnic and possibly ruled by foreign Maya elite—a strategy also suggested for other parts of the Maya world (Demarest 1996; Gerstle 1987; Maca 2009; Maca and Miller 2009; McNeil 2009; Price et al. 2008). These studies and others bring into question the validity of the *sian otot* model for understanding Classic Period sociopolitical organization and explaining sociopolitical organization at Copán because of the model's focus on ethnographic analogy and lack of emphasis on how different institutions—families, households, temples, palaces, dynasties—influenced societal organization (Watanabe 2004). Thus, while I use W. Fash's *sian otot* boundaries (they appear to reflect discrete clusters), I do not necessarily advocate the *sian otot* model.

I contend that comparing differences in access and visibility of apparent architectural clusters (or sub-communities) to the archaeological record is a starting point for studies investigating ethnic, temporal, and functional diversity at Copán. Because archaeological excavation is an expensive and time-consuming activity, the identification of distinct patterns in sub-community organization is a useful and worthwhile first step. By identifying areas that are more likely to yield information about differences, than about similarities in sociopolitical organization my research seeks to offer a new direction (via access and visibility) for investigating questions of social diversity, whether it is due to ethnicity, class, temporality, or other factors.

Seeking to identify unique and distinct patterns is not new; in fact, it is precisely those studies that have identified anomalies in the archaeological record that validate my research, because they provide evidence supporting a large amount of social diversity (beyond simply social status) at Copán. Four lines of evidence, in particular, are important to my research, as they point to the existence of sub-groups and/or sub-communities in the valley. These lines of evidence relate to the possible presence in Copán of a foreign enclave, foreign "Maya" elite, *sian otots*, and nine powerful community-based lineages.

A Lenca Enclave

In the 1920s, Sylvanus Morley posited that prior to the arrival of Yax K'uk Mo, the dynasty's founder, in AD 426, Copán was occupied by a local, non-Maya populace (W. Fash 2001). The idea of a non-Maya Copán, however, was quickly disregarded (see Longyear 1952 for an exception) and was not revisited until recently as reseachers have begun to re-examine Morley's initial postulation (Hall and Viel 2004; Maca 2009; Maca and Miller 2009; McNeil 2009). Archaeological evidence suggests that groups from El Salvador, the Pacific Coast, and central Honduras may have lived in the Copán Valley during the Preclassic period (1300 BC–AD 250). Of particular interest are the Lenca, a non-Maya indigenous group living in west-central Honduras.

Research in the late 1980s identified the possible presence of a Lenca enclave in Plazas D and K of Group 9N-8 in the suburb of Las Sepulturas (W. Fash 2001; Gerstle 1987). Several lines of evidence support this hypothesis. The occupants of Patios D and

K had a lower social status within Group 9N-8, as evidenced by lower-quality construction and burial goods. Access to both plazas was very restricted. Each plaza had two narrow passages that could be reached only after walking through several other courtyard groups, suggesting that movement to and from Plaza D was tightly controlled. Additionally, although all occupants of Group 9N-8 apparently used Lenca ceramics (Ulua polychromes), excavators found significantly higher proportions in Plazas D and K. Moreover, they found Lenca ceramics in burial and ritual contexts in Patios D and K, but only in domestic contexts in the rest of Group 9N-8 (Gerstle 1987). Gerstle (1987) interprets these data as evidence of a Lenca enclave of political representatives or "royal hostages" that lived at Las Sepulturas to ensure Lenca cooperation with Copán.

Foreign "Maya" Elite

Recent strontium-isotope data from some burials and ceramic materials from across the valley not only support Gerstle's (1987) supposition of ethnic diversity but also suggest the presence of a heterogeneous population, larger than a fifty to sixty person enclave. Strontium-isotope and epigraphic evidence indicate the presence of non-local Maya elite at least as early as AD 426 with the immigration of Yax K'uk' Mo' to Copán (Buikstra et al. 2004; Price et al. 2008). The data indicate that he was born into a ruling family at Caracol, Belize, spent part of his youth as a member of the royal court at Tikal, and then journeyed to Copán to found a new dynasty (Price et al. 2009; Stuart 2007).

New archaeological and skeletal data indicate that the practice of elite emigrating from the Petén or other regions to Copán continued into the Late Classic. Strontium-isotope data from a high-status burial dated to the seventh century in Group 11K-6 in the suburb of El Bosque most closely correspond to strontium-isotope signatures from the Pasion Region of Petén, suggesting that the entombed individual spent his childhood at the Maya site of Seibal or Aguateca, Guatemala and that he arrived at Copán later in life (Maca and Miller 2009). However, there are currently no strontium-isotope signatures for central Honduras, and according to Allan Maca and Katherine Miller (2009), future strontium-isotope studies may determine that the individual originated from the interior of Honduras—providing another connection to the Lenca in central Honduras.

The ceramic data from sites across the valley also support the possible long-term presence of non-local elite. While the majority of Copanecos used locally made or non-Maya ceramics originating from the Lenca region to the east and other non-Maya areas to the South, few people, with the exception of some urban elite, had access to southern lowland Maya ceramics (W. Fash 1983a). These data support recent arguments that despite the fact that the city's elite accoutrements were Maya, some if not many residents may have been essentially non-Maya, probably Lenca (Maca 2009).

The data, while not conclusive, allow for the possibility of a foreign elite quite literally surrounded by a non-Maya population. The high-status elite, aggregated in the urban core, may have spatially (and socially) organized themselves somewhat differently from people, seemingly often from a lower class, living in the hinterlands. As Allan Maca (2009:97) notes, following McAnany (1995), archaeologists cannot assume that "elite and non-elite segments vary in scale and not in kind." These differences have important implications for understanding sociopolitical organization at the site, especially outside the urban core, where there have been fewer archaeological excavations explicitly focused on studying non-urban sub-community dynamics (for exceptions see Freter 2004; Whittington 1989).

If many non-urban Copanecos were non-Maya, or even the recent descendents of a local non-Maya indigenous population, then sociopolitical organization outside the urban core and beyond direct control of the city's "Maya" elite may have differed from that at other, more distinctly southern lowland Maya sites. Differences in sociopolitical organization, in turn, would likely lead to distinct settlement patterns in the archaeological record. And, in fact, Copán's settlement pattern exhibits three distinct differences from other Maya sites: (1) smaller house platforms, (2) residential units with more than one patio or enclosed space, and (3) a large number of "non-patio" or informal groups (W. Fash 1983a; Maca 2009). Because of the link between settlement patterns and sociopolitical organization, it is likely that Copán's sociopolitical organization was somewhat different from that of other Maya sites as well. On the one hand, such differences may signify ethnic diversity; on the other hand, they may simply reflect the unique ways the Maya responded to local variation and constraints. Several scholars believe that the modern Chorti Maya, currently living in the region, are the descendants of the ancient Copanecos, and that differences in ancient settlement data reflect a distinct type of sociopolitical organization—the *sian otot* model (B. Fash 1983b, 2005; W. Fash 1983a; Freter 2004).

Sian Otot **Model**

In the late 1970s, Richard Leventhal (1979) noted that many settlement clusters at Copán were located along *quebradas*. A few years later, William Fash (1983a, 1983b) proposed the *sian otot* model (see Chapter 2 for full discussion). He argued that the modern Chorti Maya, who organize themselves around water sources, serve as an analogy for understanding sub-community organization at ancient Copán. Several researchers have built on W. Fash's original model. AnnCorrinne Freter (2004) uses the *sian otot* model as a starting point for reconstructing community organization in the hinterlands. She combines archaeological and settlement data to conclude that some sub-communities were involved in communal ceramic production, and she believes that additional archaeological data will indicate economic cooperation among commoners extended into other areas of production as well, such as plaster, wood-working, obsidian tools, and ground stone implements. Karla Davis-Salazar (2003) and Barbara Fash (2005), in contrast, focus on urban community dynamics. They posit that archaeological and iconographic data indicate that certain lineages managed the city's reservoirs. From these data they suggest that *sian otots*, or waterhole groups, formed the basis for sociopolitical organization in both hinterland and urban sub-communities.

While both studies support the existence of sub-communities, their conclusions do not necessarily imply a homogeneous Maya population. Along these lines, recent archaeological work in the Naco Valley, northeast of Copán, indicates that the Lenca in this area organized themselves into smaller communities centered around *quebradas* and specialized resources such as lithic and clay materials (Esqueda 2009). This model exhibits many similarities to the *sian otot* or *sna* (lineage) model of sociopolitical organization currently espoused for Copán's hinterlands, and thus direct ancestry to a homogeneous Maya population cannot be assumed.

The Popol Nah, Toponyms, and Nine Ruling Lineages

The fourth line of evidence indicating that distinct sub-communities existed at ancient Copán is the possible presence of nine ruling lineages organized into geographically distinct sub-communities. Several scholars interpret Structure 10L-22A, located in the East Court of the Acropolis, as a *Popol Nah*, or council house. They contend that the placement of nine figures seated on toponyms, or place name glyphs, on the building signifies a change in Copán's power structure. The capture and decapitation of Ruler 13 in AD 738 and/or a lack of direct genealogical ties between Ruler 13 and Ruler 14 weakened the royal dynasty's power, requiring that Ruler 14 renegotiate power relations with the valley's powerful elite lineages. Barbara Fash (2005; B. Fash et al. 1992) contends that nine powerful lineages formed a council and shared some degree of power with rulers at the end of the Late Classic (Cheek 2003; B. Fash 2005; B. Fash et al. 1992; W. Fash 2001; Stomper 2001). Furthermore, she believes that the toponyms represent physical locations in the valley.

For example, the south side of Structure 10L-22A portrays a figure seated above a fish glyph. Excavations in Group 10L-2, located in the southern part of the site, uncovered fish imagery, possibly supporting B. Fash's interpretation (Andrews V and B. Fash 1992). Recent excavations at an elite architectural complex in Rastrojon revealed imagery that may offer further support (Fash and Fash 2009).

However, excavations at Groups 8L-10, 8L-11, 8L-12, 9J-5 and Rio Amarillo, initiated, in part, to find toponym glyphs, were unsuccessful (Ashmore 1989, 1991; Canuto 2004; Maca 2002; Webster et al. 1998). Moreover, some scholars read the iconography and epigraphy of Structure 10L-22A as supernatural place names and not as actual earthly locations (Schele et al. 1991; Wagner 2000), and others argue that ubiquity of the fish motif at Copán negates any connection between the glyph of Structure 10L-22A and the fish imagery in Group 10L-2 (Plank 2003, 2004). While the evidence for geographically distinct sub-communities from Structure 10L-22A is ardently contested, archaeologists continue to uncover data supporting multiple interpretations.

In sum, despite ongoing debates about the nature and scale of ethnic diversity at Copán, the applicability of the *sian otot* model, and the sociopolitical significance of Structure 10L-22A, these four lines of evidence indicate that the presence of distinct settlement clusters and diverse sub-community organization is becoming more widely accepted. My research builds on these studies, seeking to understand the many layers and diversity of sociopolitical organization at Copán. By measuring access and visibility among 21 discrete spatial clusters, this study provides a new approach to reconstructing social connectivity between possible sub-communities and helps to address some aspects of the ongoing debate about sociopolitical organization at Copán.

The following discussion of some of the potential problems with the Harvard Site Typology (specifically a conflation of some site types) is used as a springboard to investigate the distinct roles that "paired sites" and sub-communities may have played in ancient Copán's sociopolitical dynamics. I conclude with several hypotheses about the "paired site" phenomenon that provide new directions for future research.

Evaluating the Harvard Site Typology

In the late 1970s, archaeologists devised the Harvard Site Typology as a heuristic device for classifying and comparing architectural groupings at Copán. They used four criteria—size, complexity, mound height, and construction materials—to create a five-part classification (Leventhal 1979; Willey and Leventhal 1979; Willey et al. 1978). Although these site types were originally meant to reflect economic status, researchers typically correlate them to social status, with smaller, less elaborate sites assigned to commoners (types 1 and 2), larger, more complex sites designated as elite (types 3 and 4), and the main civic-ceremonial groups assigned to royalty (type 5). While much of the archaeological research carried out over the past 25 years has consistently upheld the typology's ability to predict the economic status, or wealth of an architectural group (e.g., Collins 2002; W. Fash 1983a; Freter 1994), some researchers question the typology's value in predicting social function (Becker 1982; Maca 2009).

The Harvard Site Typology focuses explicitly on material remains; in contrast, my research on access and visibility investigates the more subtle nuances that both reflect and impact sociopolitical organization. By measuring connectivity between site types, this study investigates sites in a holistic manner, as part of a landscape rather than as isolated and discrete units, and thus provides an alternative way to reconstruct relationships between sites and to identify differences and similarities in site types not accounted for in the Harvard Typology.

While my results do not necessarily refute the Harvard Typology, they do not fully support it. Three general conclusions about the typology arise from the access and visibility data: (1) type 1 sites appear to be distinctly different from type 2 sites; (2) distinct differences appear to exist between type 3 and type 4 sites; and (3) distinct differences often do not exist between type 2 and type 3 sites.

One of the objectives of this research is to better understand internal social variation at Copán. The Harvard Site Typology aggregates the site's social groups into two broad categories, commoner and elite. These simplistic categories have persisted for over 30 years for four main reasons: (1) long-standing beliefs about a two-tier Maya society (see Chase and Chase 1992 for discussion of two-tier vs. multi-tier theories), (2) difficulties in using archaeological surface remains to identify variation within these classes, (3) an emphasis on excavations in the Principal Group and type 3 and 4 site in Copán's urban core (e.g., Ashmore 1991; Maca 2002; Maca and Miller 2009; Sanders 1986; Webster et al. 1988; Webster 1989), and the converse, (4) an emphasis on excavation of type 1 sites in the hinterlands (e.g., Freter 1988, 1994, 2004; Gonlin 1994; Webster and Freter 1990; Webster and Gonlin 1988). Survey and test excavation data exist for the entire valley, providing archaeologists with settlement pattern and temporal data; however, archaeologists have carried out very few extensive excavations of type 2 and 3 sites in the hinterlands.

Although we have many more data for the hinterlands than are available for most ancient Maya sites, our understanding of many aspects of Copán is still heavily reliant on data from the urban core. The result is a somewhat biased dataset. The multi-scalar nature of this study provides a way to investigate not only the urban core and the hinterlands (as discrete units) but also offers a method through which to cross urban-hinterland boundaries, allowing new and insightful observations about the relationships between and distinctions among different site types.

Site Types 1 and 2

The Harvard Typology describes type 1 and type 2 sites as distinctly different (see Table 5.1 for details). While most scholars believe that commoners occupied both site types, people living at type 2 sites are considered to have held a higher social status. The access and visibility results for all four scales of analysis indicate that differences beyond those specified in the Harvard Typology existed between type 1 and type 2 sites (see Chapters 6 and 7 for an in-depth explanation of the data and results).

In all cases, type 2 sites were more accessible than type 1 sites, indicating that people living at type 2 sites were more integrated, or connected, with society as a whole than people living at type 1 sites. In addition, in most of the valley (excepting several western sub-communities), type 2 sites were more visually connected to other Copanecos than type 1 sites. In other words, people living at type 1 sites experienced greater degrees of social segregation, suggesting that the roles that they played and the people that they interacted with on a daily basis were different from the experience of people living at type 2 sites.

Taken together, the access and visibility data not only indicate greater social connectivity for type 2 residents, they also suggest that the economic differences noted by the Harvard Typology translate into social differences, at least in terms of degrees of social integration and segregation. Simply by aggregating these two site types into a single category, commoners, archaeologists are unintentionally masking the sociopolitical and/or functional variation between these two groups. Thus, while the distinction between type 1 and 2 sites is supported, the access and visibility data highlight the need to investigate the kind and degree of the differences between these two site types.

Site Types 3 and 4

Above the commoners, but below the royalty, are the larger and more complex type 3 and type 4 sites—categorized as elite. Again the aggregation into one category masks any diversity beyond size and material wealth that may exist between these two site types. Because of their close proximity to the Principal Group, the elite occupying type 3 and type 4 sites in the urban core are often seen as members of Copán's royal court (Webster 2001). Type 3 and 4 sites in the hinterlands are believed to represent either "country" estates for an urban elite or a burgeoning social class of rural elite (W. Fash 2001; Hendon 1987; Webster 2005).

Like the type 1 and 2 results, the access and visibility data support the Harvard Site Typology's distinction between type 3 and type 4 sites; however, the multi-scalar approach again offers new information that reveals previously masked variation between them. In the urban core, statistically significant differences in access to type 3 and type 4 sites exist, suggesting that people from different social classes or people with distinct social functions lived at these two site types (see Tables 6.17 and 6.18).

The access and visibility data for the urban core suggest that there is greater connectivity between type 4 sites and the Principal Group than between type 3 sites and the Principal Group. People living at type 4 sites had greater access to the enclosed spaces of the Acropolis and the Royal Courtyard than did the occupants of type 3 sites. Individuals living at type 3 sites had less access and weaker visual ties to the city's main civic-ceremonial center, including the royal residential complex (Group 10L-2). These differences may indicate that the residents of type 3 sites in this part of the city served as middlemen, negotiating relationships between type 1 and 2 sites and type 4 sites rather than as actual members of the royal court. Again, by aggregating these two site types into a single category, elite, archaeologists are unintentionally masking the sociopolitical and/or functional variation between type 3 and type 4 sites.

Site Types 2 and 3

Despite the fact that the access and visibility results indicate clear differences, (beyond site size, complexity, and construction materials) between type 1 and type 2 sites and also between type 3 and type 4 sites, the data for type 2 and 3 sites paint a different picture. The study identifies five areas of overlap between type 2 and type 3 sites that substantiate criticisms of the Harvard Site Typology for its limitations in recognizing temporal, ethnic, functional, and/or sociopolitical variation. First, in the majority of cases, the integration values of type 2 and type 3 residential sites are more similar than the values for type 3 and type 4 residential sites. Second, for the Principal Group areas (the Great Plaza, Acropolis, and Royal Courtyard) the integration values of type 2 and type 3 sites are more similar than those for type 3 and type 4 sites. Third, many sub-communities do not exhibit significant differences in the integration values for type 2 and type 3 sites. Fourth, in Zone 3, type 2 sites are more accessible than type 3 sites. Fifth, at the valley-wide scale the differences in the visual prominence of type 2 and type 3 sites are negligible.

These multiple examples of a lack of differences between type 2 and type 3 sites is especially important because the Harvard Typology has had a major impact on sociopolitical interpretations. Currently, archaeologists consider type 2 sites to be commoner households and type 3 sites to be elite complexes. However, if type 2 and type 3 sites are more similar to each other than type 3 sites are to type 4 sites then it follows that the practice of equating site type to social status may need to be reassessed, and that the Harvard Site Typology requires refinement. While it is beyond the scope of this dissertation to create a new typology, the data highlight some patterns that provide new directions, both for refining the typology and for future archaeological investigations.

To begin with, given the size and complexity of type 3 sites, I hypothesize that it is more likely that some type 2 sites are "underclassified" rather than that some type 3 sites are "overclassified"; in other words, if the current typology structure is maintained, a subset of type 2 sites should be reclassified as type 3 sites. Even the Harvard Typology criteria categorizing the two site types are almost indistinguishable. Both type 2 and type 3 sites are comprised of 6−8 mounds, and while the typology describes type 3 sites as having dressed stone and type 2 sites as lacking dressed stone, test excavations revealed that in reality some type 2 sites have dressed stone and vaulted roofs (Webster et al. 2000). Therefore, the only major difference (using present standards) between the two site types appears to be mound height with type 2 sites averaging 2.5−3.0 meters and type 3 sites averaging 4.75meters.

Thus, both the access and visibility data and archaeological test excavations indicate a conflation of type 2 and 3 sites. The next section builds on these initial findings using the directionality data (see Chapter 9) to argue that a study of "paired sites" is a logical starting point from which to investigate the similarities between type 2 and type 3 sites. The data lead to several hypotheses about the unique roles "paired sites" may have played in Copán. The individual hypotheses take into account functional, ethnic, and temporal variation that is not accounted for in the Harvard Site Typology, and thus have broader implications for understanding sociopolitical organization at Copán.

Copán's Paired Site Phenomenon

In the late 1970s, archaeologists initiated the Proyecto Arqueológico Copán. During Phase I (PAC I) they carried out a 100% ground coverage pedestrian survey of the Copán Valley that resulted in 1:2000-scale maps covering 24-square kilometers. In the course of their dissertation work, two archaeologists, Richard Leventhal (1979) and William Fash (1983a), used these maps to study settlement patterns and to investigate sociopolitical organization in the valley. During their investigations, they identified two spatial phenomena: (1) the existence of dominant households in hinterland sub-communities and (2) the presence of paired architectural complexes.

Using ethnographic analogy, they argued that these dominant households were headed by powerful and distinct lineages. They believed that paired residences reflected the presence of two competing and cooperating lineages that were associated through marriage ties (Leventhal 1979; W. Fash 1983a). However, combining the results of my research with recent excavations at paired sites inside and outside the Copán Valley leads me to propose several alternative hypotheses about the sociopolitical significance of paired sites at Copán. These hypotheses revolve around the concepts of public vs. private function, ethnic diversity, and political strategy.

Functionality: Public vs. Private

Wendy Ashmore's (1991) excavations at the paired site called the North Group (Groups 8L-10 and 8L-12) and paired sites in the urban suburb of Salamar led her to conclude that the two sites had different functions, one strictly residential and the other, while still residential, more ritually oriented (Figure 9.2). Stephen L. Whittington's (1989) excavations at Groups 11E-2 and 10E-6, paired sites in the hinterland sub-community of Ostuman, revealed a similar pattern, that is, one group with more evidence of a ceremonial or administrative function than the other (Figure 10.3). The similarities in these paired sites suggest a question: (1) *Is it possible that Copán's paired sites do not house distinct lineages but rather reflect differences in function, by which one group served a wider civic role, possibly as a community house or community shrine, while the other served strictly as a private residence?*

The notion that the ancient Maya maintained household shrines is widely accepted and supported by both archaeological and ethnographic data (e.g., Freter 1994; Gonlin and Lohse 2007; Hanks 1990; Hendon 1987; McAnany 1995; Vogt 1983; Wisdom 1940). However, recent archaeological evidence also points to the presence of community-level shrines/temples, that is, non-state sponsored temples, in ancient Maya communities. In her article, "Classic Maya Temples, Politics, and the Voice of the People'," Lisa Lucero (2007) uses archaeological evidence from the site of Yalbec, Belize, and cross-cultural examples to argue that among the Late Classic Maya both royals and nonroyals built temples. She contends that smaller centers contained several temples with diverse patrons and that they served as "hub(s) for exchange, alliance-building, finding marriage partners, social interaction, and other activities" (Lucero 2007:409).

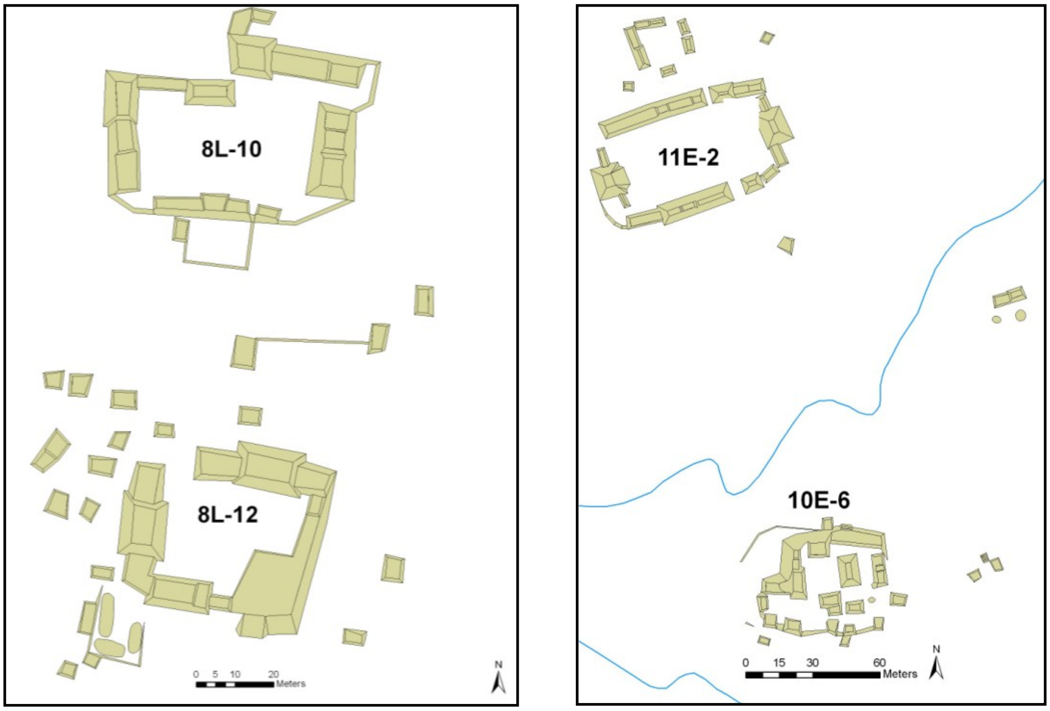


Figure 10.3: **Groups 8L-10 and 9L-12, Salamar (left), and Groups 11E-2 and 10E-6, Ostuman (right)**

Given the likelihood that multiple shrines existed at smaller Maya centers, it is conceivable that a similar phenomenon—manifested as community shrines—existed at larger centers. Investigations from the Early Acropolis Archaeological Project (ECAP) indicate that at Copán, unlike at Yalbec, the ruling dynasty erected all of the site's major civic-ceremonial temples (Bell et al. 2004); however, these findings do not negate the possibility that lesser elite constructed temples outside the Principal Group. In fact, Richard Leventhal (1979, 1983) has argued that the taller, more elaborate buildings found scattered throughout Copán's hinterland represent religious structures.

Given that thousands of people attended Great Plaza ceremonies at Copán and that the temples of the Acropolis were restricted to a small subset of elite, the Principal Group was probably not an ideal location for alliance-building, marriage negotiations, and other social exchanges among the lesser elite and commoners. Therefore, it follows that certain social groups, especially those distantly located from the Principal Group, would have needed places closer to home to carry out such activities. I posit that these places may have come in the form of community houses or community shrines/temples that may or may not have been state-sponsored.

Archaeological excavations in rural areas such as El Jaral, Llano Grande, El Limon, and Rio Amarillo to the east and northeast of the Copán Valley located several large type 3 sites that clearly served as ritual centers for their communities (Paine and Freter 1996; Webster et al. 1998). While archaeologists have yet to discover any sites (outside the Principal Group) completely devoted to ritual (without a residential component) work at the paired sites of 8L-10 and 8L-12 in Salamar and the paired sites of 10E-6 and 11E-2 in Ostuman reveal a functional dichotomy.

Ashmore's (1991) excavations at the Salamar sites revealed imagery, architecture, and settlement form at Group 8L-10 indicating that it served a wider civic role than Group 8L-12, which was strictly residential. Group 8L-12 has portrait sculpture with personal references to an individual, in contrast to the more generalized and thematic symbols found in Group 8L-10. The buildings of Group 8L-12 occupy a smaller, more enclosed courtyard than 8L-10, "the visual effect being one of enclosed or private space in 8L-12 and open or public space in its northern neighbor" (Ashmore 1991: 215). Furthermore, the numerous small ancillary structures surrounding 8L-12 suggest the presence of kitchens, storehouses, and servant residences, all indicative of a more residential function. Such auxiliary structures are basically absent from 8L-10.

Whittington's (1989) excavations at the Ostuman sites revealed little evidence of daily production activities at Group 10E-2, suggesting that it served an administrative or ritual purpose. In contrast, the material remains (e.g., obsidian and bone tools) from Group 11E-2 indicate that this site served both production and residential purposes. Whittington, like Ashmore (1991), concludes that the sites played complementary roles—one oriented toward civic duties, the other as a private residence.

Given the patterns revealed at these paired sites, the question arises: *Do similar patterns exist at other paired residences in the valley, suggesting that they too had similar private vs. public functionality?* However, prior to examining data from other paired sites, it is necessary to lay the groundwork for two alternative explanations for the paired site phenomenon.

Ethnic Diversity: Lenca vs. Maya and/or Political Strategy?

The demographic composition, temporality, scale, and nature of ethnic diversity at Copán remain controversial. Preclassic period (1300 BC−AD 250) archaeological materials and settlement patterns indicate the presence of a non-Maya population from El Salvador, the Pacific Coast, and/or central Honduras (Canuto 2004; Hall and Viel 2004; McNeil 2009). Archaeological and paleoenvironmental data identify three possible migration events into the Copán Valley during the Early Classic period (AD 250−600). Pollen data provide evidence for the first migration. McNeil (2009) argues that the introduction in AD 250 of coyol palm, a plant indicative of the Maya, marks the initial immigration of Chorti Maya to the valley. A second migration occurs almost 200 years later in AD 426 with the arrival of Yax K'uk Mo, the dynasty's founder, and his entourage (Sharer 2004). A few years later, around AD 430, the eruption of the Ilopango volcano brought refugees from El Salvador.

Scholars typically assume that Classic period (AD 600−822) settlement was homogeneously Maya (except for the possible presence of a small Lenca enclave in Las Sepulturas) (e.g., W. Fash 1983a, 1983b, 2001; Freter 2004;); however, because the nature and extent of Late Classic ethnic diversity is little understood, some researchers have begun to question this assumption (e.g., Maca 2009). Ethnic diversity in the Postclassic period (AD 822-?) is quite controversial. The debate revolves around the nature and length of the city's collapse. On one side of the debate are the proponents of a gradual collapse, who contend that population rates were still as high as 15,000 people around AD 950, and while population continued to decline, they argue that the Classic period inhabitants, presumably Maya, still lived in the valley until at least AD 1250 (Webster 2005; Webster and Gonlin 1988). On the other side of the debate are advocates for a rapid collapse, who contend that by AD 950 the Classic period inhabitants were gone and a small-scale occupation of foreigners, most likely from central Honduras, occupied part of the site (Manahan 2003, 2004).

Most researchers agree that Copán's location on the southeastern periphery of the southern Maya lowlands contributed to its cosmopolitan nature, and archaeological evidence from outside the Copán Valley supports this belief. Recent work in the Río Amarillo Valley, 20 km east of Copán, and the El Paraíso Valley, 27 km northeast of Copán (Canuto and Bell 2008), has revealed paired sites that reflect ethnic differences.

Differences in the spatial organization, architectural style, material goods, and special deposits and features of two sites in the Río Amarillo Valley, Los Achiotes and El

Raizal, reflect distinct stylistic affiliations and different forms of social organization (Canuto 2004; Manahan and Canuto 2009). For example, Los Achiotes exhibits (1) household platforms arranged around a large open plaza, (2) houses located at the edge of the hilltop (except on the west), (3) two large terraced platform structures and an altar in the south, (4) open and accessible patios, that is, a high degree of spatial openness, (5) no clear boundaries to the group, and (6) fine wares identical to those found at Copán but utilitarian wares that were not found at Copán. In general, the spatial organization of Los Achiotes is similar to other sites nearby.

In contrast, El Raizal has (1) a tight, spatially nucleated organization, (2) restricted access evidenced by a single entrance to the northwest, (3) a single range structure dividing the site, (4) a sunken western patio, (5) distinct internal patios, and (6) open space and high visibility on three sides. In general, El Raizal resembles larger elite complexes at Copán and Río Amarillo rather than nearby settlements (Canuto 2004). Canuto (2004) argues that the differences between these two sites reflect pre-dynastic vs. dynastic conceptions of space and planning as well as political policies. He writes,

> the dynasty of K'inich Yax K'uk' Mo brought massive changes to how the Copan polity integrated its hinterlands. So much so that pre-dynastic Copan's lack of influence on Los Achiotes compares sharply with dynastic Copan's influence on rural communities like El Raizal [Canuto 2004:49].

Together the data suggest that a local, non-Maya indigenous population, most likely the Lenca, inhabited Los Achiotes and that Copanecos or close affiliates of the city occupied El Raizal.

While in his earlier publication, Canuto does not directly state that the paired site phenomenon in the Río Amarillo Valley reflects ethnic diversity, he and Ellen Bell

(Canuto and Bell 2008) make this argument for paired sites in the El Paraíso Valley. Canuto and Bell hypothesize that a local non-Maya indigenous group—the Lenca—inhabited the site of El Cafetal and that allies or members of Copán's elite occupied the site of El Paraíso. Interestingly, these paired sites display many of the same characteristics of Los Achiotes and El Raizal.

In general, the two sites exhibited distinctly different spatial plans, architectural styles, decorative regimes, and ceramic assemblages. El Cafetal, the non-Maya site, had (1) large, open plazas surrounded by long, cobble-masonry substructures, (2) mostly perishable superstructures, (3) unadorned buildings with no sculpture and very little stucco, (4) Copan-made ceremonial wares but local-made utilitarian wares, (5) open access, and (6) low visibility. In contrast, El Paraíso, the Maya site, exhibited (1) quadrangular sunken courts separated by elevated platforms, (2) residential and administrative masonry buildings with stucco (3) Copán-style mosaic sculpture (von Schwerin 2009), (4) Copan-made ceremonial and utilitarian wares, (5) restricted access, and (6) high visibility. Like El Raizal, it resembles many secondary centers in the Copán region.

Canuto and Bell (2008) argue that the paired site phenomenon found in the Río Amarillo and El Paraíso Valleys and in other areas of the Copán polity (e.g., Rio Amarillo, La Florida, and La Venta; (Canuto 2002; Nakamura et al. 1991; Schortman 2001; Vlcek and Fash 1986) reflects a political strategy on the part of Copán in which Maya-like sites located in non-Maya regions served as outposts located at "strategic locations near and over-looking the centers of rural indigenous populations" (Canuto and Bell 2008:16). Given these circumstances, the following questions arise: *Are the patterns* *found at paired sites outside the Copán Valley also found at paired sites in the Copán Valley?* And if so, *do they reflect actual ethnic differences, for example, Lenca vs. Maya, at Copán* or *do they simply signify a political strategy in which Copán's elite used "outposts" to control particular areas within the city itself?*

These two explanations do not exclude the possibility that paired sites reflect temporal differences such as those seen at Los Achiotes and El Raizal. For example, one site of a pair may exhibit a longer, more continuous occupation and thus have ties to earlier forms of sociopolitical organization, possibly non-Maya customs and practices. Conversely, the other site in the pair may reveal a shorter occupation and reflect later forms of sociopolitical organization that may have been more directly influenced by Maya customs and practices. However, in order to discuss the likelihood of each of these explanations, it is necessary to identify the similarities and differences of Copán's paired sites to paired sites found outside the valley. Because archaeologists have not excavated most of these sites, my analysis is limited to: spatial organization, accessibility, and visibility; therefore, my goal is not to advocate a single hypothesis that explains the paired site phenomenon at Copán, but rather to offer several hypotheses that provide a springboard for future research.

GIS Data for Copán's Paired Sites

Currently available data suggest that there are eight paired sites at Copán. W. Fash (1983a, 1983b) documents three paired sites, in the hinterland sub-communities of Mesa de Petapilla, Titichon, and Ostuman. He states that the pairing is obvious because "there is virtually nothing in the way of settlement between the two groups" (W. Fash

1983a:289). Although not mentioned by W. Fash, Groups 8L-10 and 8L-12 in Salamar constitute a fourth paired site. Using the GIS to investigate the valley's settlement patterns, I identified four more similarly paired groups, three in the sub-communities of Rastrojon, San Lucas, and Algodonal/Estanzuela, and a second pairing in Ostuman.

The GIS data indicate that these pairings have complementary characteristics that reflect a duality. They include one site that (1) has a more formalized and compact organization, (2) contains one patio rather than several patios, (3) has few or no ancillary structures such as kitchens and storehouses, (4) contains a structure that is possibly larger and taller than others in the group and/or is pyramid-shaped, (5) is relatively isolated from other architectural complexes, (6) has restricted access, (7) exhibits higher visibility, and (8) is a type 2 or type 3 site (except for 10E-6 in Ostuman). In addition, all paired sites are oriented north-south rather than east-west. However, the position of the more formalized, isolated, and restricted-access yet highly visible site is not consistent, that is, sometimes it is located to the north and other times to the south.

Interestingly, this same duality of characteristics was revealed in excavations at four paired sites—two at Copán and two in nearby valleys: first, at Groups 8L-10 and 8L-12 in Salamar where Group 8L-10 played a wider civic role; second, at Groups 10E-6 and 1E-6 in Ostuman where, like Salamar's paired sites, one group (Group 10E-6) played an administrative or ritual role and the other (Group 11E-6) functioned strictly as a private residence; third, at the sites of Los Achiotes and El Raizal, which Canuto (2004) believes represents pre-dynastic vs. post-dynastic conceptions of space and planning—in effect, ethnic differences; and fourth, at the sites of El Paraíso and El Cafetal and in the El Paraíso Valley, which Canuto and Bell (2008) argue signifies ethnic differences. The next section summarizes the characteristics of Copán's eight paired sites to compare them to these four archetypal paired sites.

Mesa de Petapilla

The sub-community of Mesa de Petapilla contains the paired sites of 5O-1 and 5O-8 (both type 3) (Figure 10.4). The two complexes are about 165 meters apart. Group 5O-1, the northern group, consists of 28 mounds oriented along a northwest-southeast axis, contains at least four plazas, appears to have several scattered ancillary structures giving it a less formalized and compact appearance, and has open access and low visibility. Group 5O-8, the southern group, consists of 11 mounds oriented along a northwest-southeast axis, contains only one plaza, is more compact, formalized, and isolated, may house a pyramid-shaped structure (Str. 5O-65), and has high visibility (see Figures 9.25 and 9.26). The spatial layout, accessibility, and visibility of these two sites replicate the duality found at the archetypal paired sites.

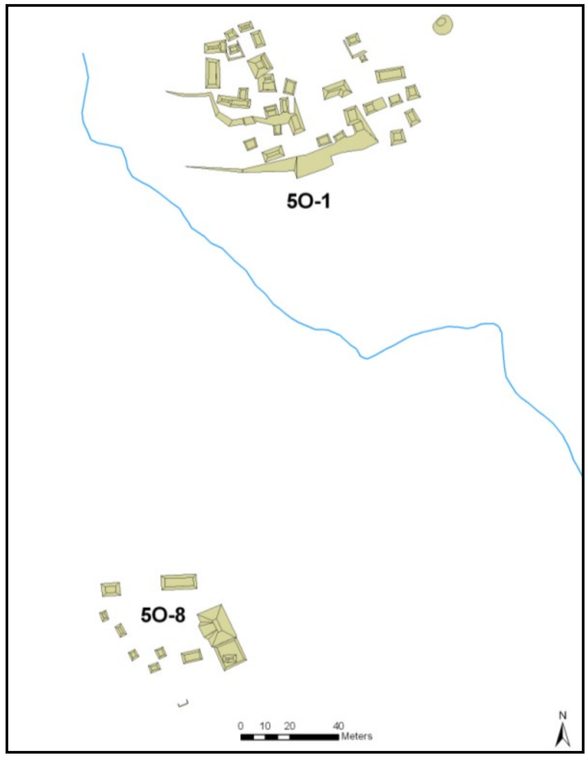


Figure 10.4: **Paired sites (Groups 5O-1 and 5O-8) in Mesa de Petapilla**

Titichon

The sub-community of Titichon contains the paired sites of 9P-1 and 9P-5 (both type 2) (Figure 10.5). The two complexes are approximately 100 meters apart. Group 9P-1, the northern group, has seven mounds, and one plaza, is compact, formalized, and isolated, may house a pyramid-shaped structure (Str. 9P-1), and has restricted access. Group 9P-5, the southern group, contains 15 mounds and at least two plazas with scattered ancillary structures in an informal and loose organization, does not appear to have a pyramid-shaped structure, and has relatively open access. The spatial layout and accessibility replicate the archetypal paired sites; however, the sites have similar degrees of visibility, with expansive views toward the west and the Principal Group.

Figure 10.5: **Paired sites (Groups 9P-1 and 9P-5) in Titichon**

Ostuman

The intermontane sub-community of Ostuman is somewhat different from other hinterland sub-communities in that it may actually contain two paired sites—Groups 10E-6 (type 4) and 11E-2 (type 3) and Groups 10F-1 (type 3) and 10F-3 (type 2). W. Fash (1983a, 1983b) identified the first pairing, Groups 10E-6 and 11E-2 (Figure 10.3), the sites are about 140 meters apart, and both have expansive views of the mountains to the northwest. Group 10E-6, the northern group, consists of 13 mounds oriented along a northwest-southeast axis, contains two plazas (one of which exhibits controlled access), has a formalized and compact layout, and appears to have a pyramid-shaped structure

(Str. 10E-34). Group 11E-2 (Figure 10.6), the southern group, comprises 18 mounds, contains at least three plazas, and has relatively open access. Whittington (1989) concluded from his excavations at the site that Group 10E-6 was more ritually focused than its southern counterpart.

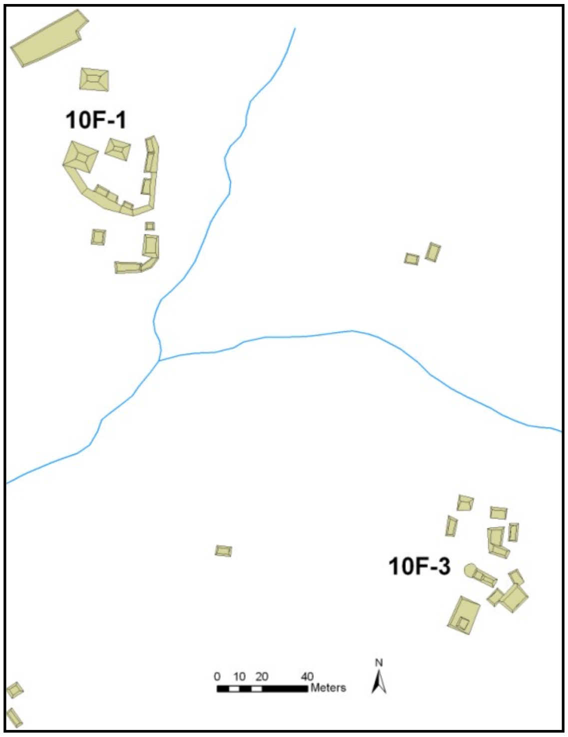


Figure 10.6: **Paired sites (Groups 10F-1 and 10F-3) in Ostuman**

While W. Fash (1983a, 1983b) did not identify Groups 10F-1 and 10F-3 as paired, I contend that they exhibit characteristics similar to those of other pairings in the valley. The complexes are approximately 165 meters apart and, like other paired sites have no visible settlement between them. Group 10F-1, the northern group, consists of 12 mounds and contains three informal plazas with scattered structures. Group 10F-3, to the southeast, consists of eight mounds and at least two plazas, and exhibits a more compact design than its northern counterpart. The spatial layout and accessibility of both sites are similar to the archetypal paired sites; however, like Titichon's paired sites, they have similar degrees of visibility.

Salamar

The sub-community of Salamar contains the paired sites of 8L-10 (type 3) and 8L-12 (type 4) (Figure 10.3). The complexes are spaced about 40 meters apart. (High settlement density in the urban core may have necessitated the close proximity of these two sites, which were constructed in the early eighth century.) Group 8L-10, the northern group, comprises nine mounds, one plaza and few or no ancillary structures, and exhibits a compact and formalized organization. Moreover, Ashmore (1991) contends that this site is more visible than its southern counterpart. Group 8L-12, the southern group, comprises 21 mounds and at least three plazas, and has an informal design with several scattered ancillary structures. The spatial layout, accessibility, and visibility of both of these sites replicate the archetypal paired sites.

Rastrojon

The sub-community of Rastrojon contains the paired sites of 6N-1 and 6N-2 (Figure 10.7). The two complexes are about 50 meters apart. Group 6N-1, the northern group, consists of 14 mounds, at least two plazas with many ancillary structures, has less formalized and loose organization that results in open access, and exhibits lower visibility than its southern counterpart. Group 6N-2, the southern group, consists of 7 mounds and one plaza, is compact and formalized, has few ancillary structures, is more isolated, has restricted access yet higher visibility, and may have a pyramid-shaped structure (Str. 6N-15). The spatial layout, accessibility, and visibility of these two sites replicate the duality found at the archetypal paired sites.

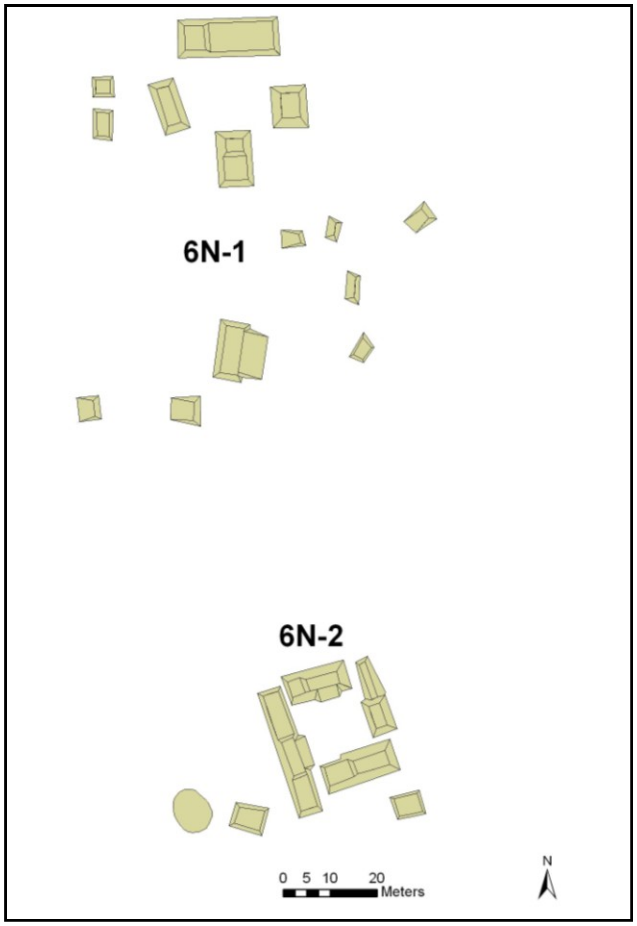


Figure 10.7: **Paired sites (Groups 6N-1 and 6N-2) in Rastrojon**

San Lucas

While not identified by W. Fash (1983a, 1983b), the GIS data suggest that 11M-10/11M-11 (type 2) and 12M-1 (type 2) in the sub-community of San Lucas are paired sites. I have aggregated Groups 11M-10 and 11M-11 into a single site, as they are only 15 meters apart and are oriented along the same northwest-southeast axis. Groups 11M-10/11M-11 and 12M-1 are about 180 meters apart (Figure 10.8). Group 11-10/11M-11, the northern group, comprises 23 mounds, at least three plazas, many scattered ancillary structures, and is less formalized and compact than its southern neighbor. Group 12M-1 consists of six mounds, only one plaza, few or no ancillary structures, and is more formalized and compact than its northern counterpart.

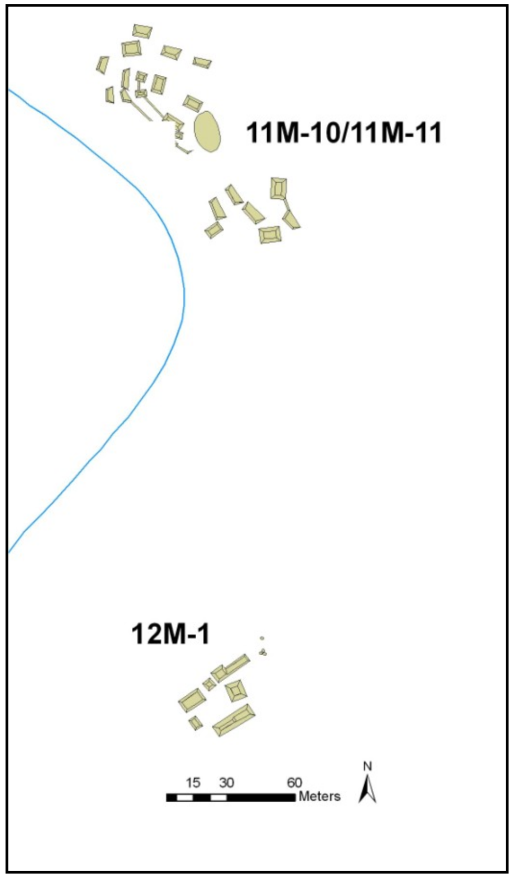


Figure 10.8: **Paired sites (Groups 11M-10/11M-11 and 12M-1) in San Lucas**

The two sites have very different visual domains. In contrast to other less formalized and openly accessible paired sites, Groups 11M-10/11M-11 have a large visual domain (see Figure 9.40), and Group 12M-1, the smaller, more compact site, has a smaller visual domain (see Figure 9.41). Interestingly, Group 11M-10/11M-11 has very strong visual ties to other sub-community sites, whereas Group 12M-1 exhibits strong visual ties to the Principal Group and not to other sub-community households. Thus, while the visibility patterns differ somewhat from the archetypal paired sites, they still exhibit a duality that suggests differential functionality, ethnicity, and/or temporality. Moreover, the spatial layout and accessibility of these two sites replicate the duality found at the archetypal paired sites.

Algodonal/Estanzuela

Although Groups 12F-3 (type 3) and 12F-4/13F-1/13F-2 (type 2) seemingly cross sub-community boundaries, they exhibit several characteristics that suggest that they are paired sites. Like the northern group in San Lucas, I have aggregated groups (12F-4, 13F-1, and 13F-2) because they are spaced close together and appear to form a single site (see Figure 9.45). The paired sites are approximately 200 meters apart, have no obvious settlement between them, and are oriented along a north-south axis (Figure 10.9).

Group 12F-3, the northern group, is in the sub-community of Algodonal. It comprises 12 mounds and two plazas, its design is more compact and closed than that of its southern neighbor, and it has strong visual ties to the Principal Group. The fact that the residents of 12F-3 required or desired strong visual ties to the city's main civic-ceremonial suggests that perhaps they were part of a particular social group or played a specific role in society that necessitated closer contact with Copán's royalty than did the inhabitants of Groups 12F-4, 13F-1, and 12F-2.

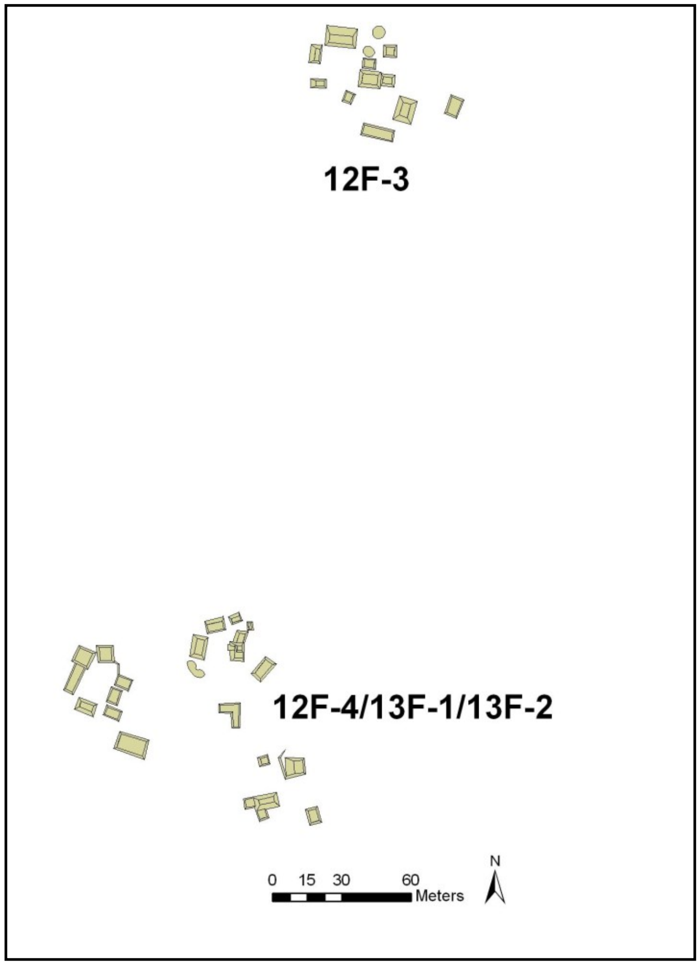


Figure 10.9: **Paired sites (Groups 12F-3 and 12F-4/13F-1/13F-2) in Algodonal-Estanzuela**

Synopsis of GIS Data for Paired Sites

The GIS analysis identified many similarities among Copán's paired sites that support the duality hypothesis. All paired sites exhibit similar spatial organization and accessibility, with one site that is more formalized, compact, restricted, and isolated, and often houses a single structure that is larger, taller, or pyramid-shaped, and another site that is less formalized, openly accessible, and less isolated. With respect to visibility, five of the more formalized and compact sites are more visible or have a visual domain linking them to the Principal Group; the other three paired sites exhibit little or no difference in their visual domains. Two of the paired sites (11E-2/10E-6 and10F-1/10F-3) with visibility values that do not fit the pattern are located in Ostuman, a somewhat secluded intermontane area with very weak visual ties to other sub-communities. The other anamolous paired sites (9P-1 and 9P-5) are in Titichon, and though they have strong visual ties to the Principal Group, they have virtually no visual ties with other members of their sub-community. Thus, all of the more formalized and more compact sites in a set of paired sites have either higher visibility than their less formalized and more accessible counterparts or exhibit strong visual ties to the Principal Group.

Possible Hypotheses Explaining Paired Sites

While it is promising that Copán's paired sites replicate, in great part, the pattern found at the archetypal paired sites, it is unfortunate that the characteristics used to explain the significance of the archetypal paired sites tend to overlap. Consequently, the questions about functionality, ethnicity, and temporality still remain. (1) *Do the patterns found at paired sites denote a private vs. public functionality?* (2) *Do the patterns found at paired sites reflect actual ethnic differences, such as Lenca vs. Maya, at Copán*? (3) *Do the patterns found at paired sites signify a political strategy in which Copán's elite used "outposts" to control particular areas of the city, regardless of the occupants' ethnicity?* (4) *Do the patterns indicate temporal differences between paired sites?*

Furthermore, the data do not necessarily negate W. Fash (1983a, 1983b) and Leventhal's (1979) original hypothesis that paired sites represent two distinct households occupied by competing lineage groups. Given these issues, I posit several hypotheses, which are not necessarily mutually exclusive, to explain the paired site phenomenon at Copán. Additionally, I seek to understand the possible significance/relevance of the access and visibility patterns identified for Copán's paired sites by addressing the following questions in relation to each of the proposed hypotheses: (1) *Why is the compact, more formalized site always less accessible and typically more visible?* and (2) *Did restricted access and higher visibility serve particular purposes at these sites?*

Hypothesis 1:

> **Architectural pairings in the Copán Valley reflect two distinct lineage groups (from Leventhal 1979 and W. Fash 1983a, 1983b).**

Richard Leventhal (1979) and William Fash (1983a, 1983b) argued that lineage heads of competing and collaborating extended families with marriage ties occupied Copán's paired sites. The directionality data acquired in this research may support their original hypothesis that these sites, or rather some of these sites, represent distinct lineage groups. The viewshed data indicate that the visual domains of some paired sites did not overlap, suggesting that the occupants of the two sites sought to visually address different groups of people.

The ancient Maya considered those who were all-seeing as high status individuals, who played authorizing or witnessing roles in society (Houston et al. 2006:173). These beliefs about vision suggest that the physical presence of an overlord was of critical importance to the ancient Maya, as it is for some contemporary Maya (Vogt 1983). Thus, the distinctly different visual domains of paired sites support the belief that local landlords, each from a distinct lineage, lived at these sites and overlooked different lands and distinct sub-communities. However, the fact that one paired site is almost always more open and accessible while the other's access is restricted is difficult to reconcile with this hypothesis. *Why would one lineage require greater isolation and more restricted access than another lineage?* A possible explanation is that the paired sites do not represent two lineages but rather a single lineage in which a relative (e.g., a newly married son) founded a new architectural complex on nearby family-owned lands. In this case, a short occupation span accounts for the site's compact, formalized design and sense of isolation (W. Fash 1983a). In other words, not enough time passed to construct multiple plazas and accrue many ancillary structures.

The first step in testing this hypothesis is to link the available survey and test excavation data to the Copán GIS. The next step is to investigate the ceramic data for the paired sites in order to establish preliminary timelines for the sites. While the PAC I survey broadly categorized most hinterland sites as Late Classic (AD 600−AD 900), a re-analysis of the ceramics using Cassandra Bill's (1997) updated ceramic typology may help to narrow this 300 year time span. The third step is to carry out test excavations at a sample of paired sites. This is important for two reasons: (1) many paired sites lack any excavation data and (2) some archaeologists contend that the Late Classic bias of earlier research designs led excavators to overlook Early Classic (AD 250−600) components at hinterland sites (Canuto 2004; Sharer 2004). While temporality cannot itself identify whether one or two lineages occupied paired sites, it can help to support or refute the explanation that a short occupation sequence accounts for one site's compact, formalized design and sense of isolation and a longer occupation sequence is responsible for the other site's numerous plazas and informal and open design.

Hypothesis 2a:

> **Paired Sites in the Copán Valley reflect functional differences in which one site served a wider civic role, possibly as a community house or community shrine, while the other site served strictly as a private residence.**

Ethnographic data indicate that the lineage heads of many modern Maya communities are charged with maintaining a community shrine, which is often located in or near their households (Vogt 1983; Wisdom 1940). Archaeological evidence suggests that among the ancient Maya individual families not only maintained household shrines (Gonlin and Lohse 2007), but that some powerful nonroyal lineages also sponsored community temples/shrines (Lucero 2007). Excavations at two sets of paired sites at Copán (Groups 8L-10 and 8L-12 and Groups 10E-6 and 11E-2) suggest that the paired site phenomenon may reflect dual functionality, with one site less formalized, with several patios and ancillary structures, and lacking a single distinct and conspicuous structure suggesting that it served a more private, residential function. In contrast, the other site was more formalized and compact, usually had only one patio and few or no ancillary structures, and housed a single distinct and conspicuous structure, suggesting that the site, while still residential, served a more public, possibly ritual purpose.

While archaeologists have excavated at only two paired sites, several others exist in the valley—all in the hinterlands. The spatial organization of these paired sites typically replicates the spatial patterning found at the excavated paired sites. In addition, the formalized and compact sites in these pairs are somewhat isolated, located in areas with little or no surrounding settlement, and consequently they often have higher visibility than their counterparts. According to Leventhal (1979, 1983), several hinterland sites have taller, more conspicuous structures that served ritual purposes. He argues that they were often placed in locations that would make them seem "larger than life." Perhaps some sites were intentionally isolated in order to make them more visible; their isolation would thus have served a similar purpose—higher visibility—in line with the "larger than life" hypothesis. In other words, Copanecos marked hinterland ritual sites via a combination of distinct spatial organization, isolation, and higher visibility. Additionally, the wide-open spaces surrounding these sites may represent gathering places where people set up temporary structures or stalls associated with community-level ceremonies and events.

Along these lines, the presence of non-residential ritual centers in rural areas such as El Jaral, Llano Grande, El Limon, and Río Amarillo outside of Copán (Freter 2004; Paine and Freter 1996) provides a local social template for ritually focused sites. Because most paired sites are located several kilometers from the site's major civic-ceremonial center, they may have filled a need for community houses and/or shrines to deal with local-level economic, social, political, and/or religious affairs. In contrast to rural sites, Copán's "ritual" sites most likely served a dual function, both residential and ritual (e.g., Group 8L-10). Interestingly, ritual centers located outside Copán are all type 3 sites, and most of the possible ritual sites in Copán are either type 2 or type 3 sites. Given the likely misidentification of some type 3 sites as type 2, I contend that paired sites, at least the compact and formalized sites in the pairs, need to be reclassified as type 3 sites (assuming the Harvard Site Typology is used).

Ethnographic and archaeological research supports the existence of ancient Maya community shrines (Lucero 2007; Vogt 1983). They also provide a model, specific to

Copán, in which certain spatial configurations are associated with public versus private functions that may have been replicated across the valley. However, archaeological excavations are required to test this hypothesis. In the case of Groups 8L-10 and 8L-12, Ashmore's (1991) excavations uncovered iconography, burial remains, and caches that supported her hypothesis that 8L-10 served a wider civic role—a role that was ritually oriented.

Hypothesis 2b:

> **Paired sites in the Copán Valley reflect functional differences in which one site served a wider civic role, possibly housing a state-sponsored shrine, while the other site served strictly as a private residence.**

Recent archaeological and epigraphic data from several sites in Copán's urban suburbs as well as from Group 8L-10 raise the question: *Did state-sponsored shrines exist outside of Copán's Principal Group?* Such practice is not uncommon in other ancient societies. For example, in ancient dynastic Egypt the pharaohs constructed temples all around the empire to demonstrate their power and concern with providing the blessings of the gods to all citizens (Brewer and Teeter 1999).

Currently, researchers disagree on the nature of sociopolitical organization during the regime of Ruler 16, Copán's final dynastic ruler (e.g., W. Fash 2001; Maca 2002; Plank 2003, 2004; Webster 2005). Some scholars believe that Ruler 16 shared his power with some of the city's more powerful nonroyal elites, who acted as councilors to his regime—a precedent set by Ruler 14 (B. Fash et al. 1992; W. Fash 1991, 2001; Stomper 2001), others, however, disagree (Maca 2002; Plank 2003, 2004; Wagner 2000). They argue that Ruler 16, *Yax Pasaj*, maintained enough power to carry out a major urban renewal project and that as part of this revitalization effort he erected several temples/shrines in the suburb of Las Sepulturas, where he himself would perform at ritual events (Maca 2002; Plank 2003, 2004). These temples/shrines are tripartite structures that replicate the building form of Temple 22, erected by Ruler 13 (Plank 2003, 2004).

During *Yax Pasaj's* reign architectural sculpture became more widespread among nonroyal elite compounds. This line of evidence is often understood to reflect decentralized power, because nonroyal elite now had the right to images and symbols that they were not previously accorded, but what if *Yax Pasaj* actually commissioned some of the imagery (Plank 2003, 2004)? It was during this time that Structure 8L-74, a tripartite building, was constructed as part of Group 8L-10. Ashmore believes that this structure, along with others in the group, was dedicated to Ruler 13 and emphasized the "invincibility of the dynasty" (Ashmore 1991:214). Given that imagery in other parts of the city suggests that *Yax Pasaj* was preoccupied with Ruler 13 (Stuart 1989:2), perhaps he commissioned Structure 8L-74 along with other tripartite buildings in the city to reference the glory of his predecessor.

If state-built temples/shrines existed in the urban core, perhaps they also existed in the hinterlands. The presence of royal temples/shrines in the hinterlands at the end of the Late Classic would reflect less decentralization than typically believed; in contrast, nonroyal temples/shrines serving as "arenas for various noble houses, or even upstarts, to display their wealth and status" (Lucero 2007:411) would support decentralization theories. Archaeological excavations at paired sites, specifically those hypothesized to have a ritual function, may help to elucidate this ongoing debate.

Hypothesis 2c:

> **Copán had both state-sponsored and community shrines that were housed at dominant households, some of which were paired.**

Ethnographic, archaeological, and epigraphic data suggest that the ancient Maya had several types of shrines, including state-sponsored, community, and household (e.g., Gonlin 2007; Hanks 1990; Lucero 2007; Plank 2003, 2004; Vogt 1983). Therefore, it is likely that Copán too, housed several types of shrines. The type (state, community, or household), scale, status, and location of shrines were co-dependent. For example, smaller, local shrines would have served intermediate levels of society (communities or sub-communities), and the status of the occupants managing the shrine may have varied depending on location (e.g., urban vs. hinterland) as well as type; a state-sponsored shrine may have held a higher status than a community shrine.

In this case, archaeological excavations can help to identify not only the presence of shrines but also the type. Lisa Lucero (2007) uses a temple attribute analysis to identify royal versus nonroyal temples/shrines at Yalbec, Belize. The attributes in her analysis include size, quality of construction materials (e.g., fill type, faced stone traits, quality and thickness of plaster surfaces), diversity of ritual offerings, and temple features (number of staircases, location over or near a cave, reservoir or mountain, and orientation). If future excavations uncover community temples/shrines in the hinterlands at Copán, these same criteria can be applied to determine whether royal or nonroyal elite commissioned these buildings.

Hypothesis 3:

> **Paired Sites in the Copán Valley may be indicative of a settlement pattern that reflects ethnic diversity that results from the city's location on the southeast periphery of the southern Maya Lowlands.**

Since the late 1980s, archaeologists have begun to reconsider the possibility that Copán and its surrounding territory was not homogeneously Maya but rather occupied by a mosaic of Maya and non-Maya peoples (e.g., Buikstra et al. 2004; Canuto 2004; Hall and Viel 2004; Maca 2009; McNeil 2009; Price et al. 2008, 2009; Stuart 2007)—an idea originally postulated by Morley in the 1920s. During the Classic period the majority of Maya elite accoutrements are limited to urban contexts and both urban and hinterland sites are replete with Ulua polychromes (a central Honduran pottery style), and some researchers posit that the city was consisted, in part, of non-local Maya elite and a large non-Maya populace.

Archaeological excavations in two nearby valleys (Río Amarillo and El Paraíso) revealed paired sites that replicate Copán's paired sites (Canuto 2004; Canuto and Bell 2008; Manahan and Canuto 2009). Archaeologists working at these sites have argued that the site's distinctly different spatial plans, architectural styles, decorative regimes, and ceramic assemblages reflect ethnic and temporal differences. Local, non-Maya (Lenca) people inhabited the open, informal, and less visible site, which had an earlier occupation that was indicative of both non-Maya and pre-dynastic conceptions of space (Canuto 2004). Maya elite from Copán occupied the more enclosed, formalized, and visible site, which had a shorter and later occupation sequence. Consequently, there appears to be a link between site form, ethnicity, and time at these sites.

Given that Copán's paired sites exhibit many of the same spatial characteristics as paired sites from outside the valley, perhaps they reflect a similar ethnic dichotomy, with one site exhibiting local, non-Maya influences and the other more southern lowland Maya influences. Interestingly, archaeologists have noted three distinct differences between Copán's site organization and traditional Maya sites from the Petén. (1) smaller house platforms, (2) more than one patio or enclosed space, and (3) high number of non-patio or "informal" groups (e.g., W. Fash 1983a; Freter 2004; Maca 2009). *Is it possible that the open, less formalized ("informal") member of the paired group with its multiple patios represents non-Maya (Lenca) conceptions of space?* If so, *do these sites represent actual Lenca occupants? Or do they represent Lenca descendants whose social memory ties them to the past and the customs and practices of their ancestors and their "relatives" from neighboring valleys?*

In Group 9N-8's Lenca enclave archaeologists uncovered a large number of central Honduran ceramics, including Ulua polychromes and mold-made figures from clearly ritual contexts, such as cache vessels and burial offerings (Gerstle 1987, 1988). Lenca ceramics, while ubiquitous at Copán, have been found only in domestic contexts at other sites. If future archaeological excavations at some of these paired sites uncovered similar evidence or other evidence indicative of Lenca site organization (such as architectural style and other material goods similar to those found at Los Achiotes and El Cafetal), that would support recent arguments of ethnic diversity at Late Classic Copán.

Ultimately, Lenca conceptions of space are a ripe area for future research. The proposed Maya/non-Maya paired grouping as reflective of wider architectural patterning associated with different ethnic groups and uniquely "Lencan" architectural and social organization has yet to be inferred at Copán. Archaeologists must consult previous studies of settlement patterns at Lenca sites (e.g., Los Naranjos and Yarumela) in order to make more nuanced determinations of Lenca spatial and social organization and how it may materialize at and/or be adapted to Copán, whether this results in paired groupings or not.

Hypothesis 4:

> **Architectural pairings in the Copán Valley may signify an "outpost" strategy used by the elite as a means of sociopolitical control outside the urban core.**

In his original work on settlement patterns in the Copán Valley, Leventhal (1979) noted the presence of several large "isolated" sites that were oriented toward open terrain in the valley. He contends that elites living at these sites were overseers managing agricultural production on nearby lands (Leventhal 1979). Many of these isolated sites are in actuality paired.

Excavations at El Paraíso (El Paraíso Valley) and El Raizal (Río Amarillo Valley) indicate that these two paired sites were outposts inhabited by allies or affines of Copán's elite. These sites occupied "strategic locations near and over-looking…rural indigenous populations" (Canuto and Bell 2008:16). Moreover, their tight, spatially nucleated organization, restricted access, isolation, and high visibility bear a marked resemblance to the isolated, more compact member of Copán's paired sites.

Therefore, it follows that Copán's paired sites may reflect a sociopolitical strategy in which the more isolated site with its high visibility served as an "outpost" to oversee and/or manage activities and people outside the urban core. The necessity for outposts may relate to agricultural production, as posited by Leventhal (1979), or alternatively it may stem from ethnic differences at Copán. For example, if a large non-Maya population lived in the valley and was ruled by foreign Maya elite, then these outpost sites could have been occupied by Maya elite who watched over them in order to preserve social cohesion.

Hypothesis 5:

> **Paired Sites do NOT exist in the Copán Valley, and only one of the two "paired" groups was actually a dominant household. A community house or shrine may or may not exist at these dominant households.**

Archaeological survey carried out in hinterlands as well as in the vicinity of Group 9J-5 at Copán suggest that despite the fact that PAC I mapped 100% of the valley, some structures, mostly platforms, were not recorded (Maca 2002; Webster et al. 2000). Depending on the numbers of unmapped structures, two of the defining characteristics of paired sites—the absence of settlement between paired sites and the relative isolation of one of the two sites—may not be valid indicators of paired sites. As a consequence, paired sites, both with dominant status (W. Fash 1983a, 1983b; Leventhal 1979), may not actually exist in Copán's hinterlands and instead only one site in these "pairs" is truly dominant.

If these sites were not paired and only one site was dominant, that fact would provide support for Barbara Fash's (B. Fash et al. 1992) belief that powerful lineages lived not only in the urban core but also in the hinterlands. (However, it does not necessarily support her contention that toponyms from Structure 10L-22A, the *Popol Nah*, actually refer to nine physical locations of households in the valley where council members resided.) Given the important role that powerful nonroyals most likely played in state-level politics, it is likely that they also played an integral part in local-level, sub-community economics, politics, and social and religious activities, necessitating public spaces/places in the hinterlands to carry out such affairs. The directionality data from my research suggest that sub-communities may have aggregated into larger communities to form intermediate-level interaction spheres. Local seats of power housed at the area's largest architectural complexes may represent the households of powerful lineages (who may or may not have served in council with Ruler 16), some of which were located in the urban core and others in the hinterlands (see Chapter 9). However, given recent criticisms of her *Popol Nah* hypothesis, I do not contend that these large elite complexes actually represent the "places" referred to on Structure 10L-22A, but simply that they were seats of power where members of surrounding sub-communities gathered for events and traveled to deal with local level issues. (See Plank 2004 for an alternative explanation for Structure 10L-22A.)

Hypothesis 6:

> **Differences in paired sites in the Copán Valley reflect an east-west spatial division that may have been temporally influenced.**

Both the access and visibility results indicate that an east-west spatial division existed in the Copán Valley. Residents living in the urban core and eastern part of the valley, while experiencing higher degrees of social connectivity with society as a whole, simultaneously experienced greater sociopolitical control. Their movement through the city and with whom they were more likely to come in contact was more tightly controlled. Moreover, they were watched over not only by the ruler himself but also by elite members of society. In contrast, people living in the western part of the valley were somewhat segregated, and also experienced lesser degrees of sociopolitical control.

Interestingly, Copán's paired sites also exhibit an east-west spatial division. Five pairings are located in eastern sub-communities, whereas only three are situated in the western sub-communities. Duplicate pairings do not occur in eastern sub-communities; however, Ostuman, a western *sian otot*, appears to have two sets of paired sites. Most importantly, the characteristics of eastern paired sites are more standardized and the differences between the pairs are more distinct. (1) Eastern pairs have one site with only one plaza, whereas all of the western pairs, even the compact, formalized sites, have multiple plazas. (2) Eastern pairs have one site that is clearly compact and has restricted access. (3) The difference in the numbers of structures found at paired sites is greater for eastern pairs than for western pairs (e.g., Group 5O-8, Mesa de Petapilla's compact site, has 11 mounds, and its counterpart, Group 5O-1, has 28 mounds; Group 11E-2, Ostuman's compact site, has 13 mounds and its counterpart, Group 10E-6, has 18 mounds). (4) The compact, less accessible site in the eastern pairs appears to have a single structure that stands out from others in the group (in the hinterland pairs it seems to be pyramid-shaped), whereas western pairs do not always have a single conspicuous structure.

This dichotomy between the eastern and western pairings at Copán leads me to ask: *What might these differences between eastern and western paired sites signify in terms of sociopolitical organization or site function? Are these differences indicative of less sociopolitical control and/or processes of decentralization in the western part of the* *valley that coincide with the region's late occupation? Do these differences indicate that the two sites in eastern pairings had separate and distinct functions, that is, public vs. private, but the sites in the western pairings did not?*

Ceramics from the PAC I survey and excavations, carried out in the late 1970s, indicate that Copanecos did not settle the western part of the valley until the Late Classic period; the central and eastern parts were settled much earlier (W. Fash 1983a; Hall and Viel 2004; Webster 2002). If settlement in the western part of the valley occurred later than in the central and eastern regions, then the differences between sites in eastern pairs may reflect earlier patterns of social organization, while western pairings reflect later patterns. They may also indicate that certain norms were no longer being adhered to or enforced at Copán, as at the end of the Late Classic people experienced environmental, ideological, and sociopolitical stresses (W. Fash 2001; Webster 2002). Thus, perhaps the differences in eastern and western paired sites mirror changes in social organization; reflecting underlying changes in social structure that were brought about at the end of the Late Classic.

Of note, Kristin Landau (2009), in her recent reanalysis of the ceramics from Groups 10E-6 and 11E-2 in Ostuman using Cassandra Bill's (1997) updated ceramic typology, contends that occupation of 11E-2 actually began as early as the Early Classic period (AD 500−600). Therefore, ceramics from other western sites need to be reanalyzed using Bill's typology to determine the extent of Early Classic occupation in the western part of the valley. Given these new data, perhaps the variation between eastern and western pairings does not reflect temporal differences but rather differences in site occupants. In general, there are fewer elite sites in the western part of the valley. If the majority of the city's occupants were non-Maya elite, then perhaps these differences reflect a non-Maya style, and with fewer Maya elites in the area there may have been less direct control over site organization and site function in the west, as indicated by the access and visibility results.

Conclusions

Given that the goal of this study was to use measures of access and visibility to reconstruct social connectivity at Copán, it is beyond its scope to answer questions of functionality, ethnicity, and temporality. Instead, the study provides a springboard for future research offering new information on spatial organization and social connectivity at Late Classic Copán. In the last section, I offered a set of hypotheses to be tested in future GIS analyses and excavations. The final section of this chapter focuses on how the new data acquired in my research helps to evaluate the utility of the Harvard Site Typology, whose acceptance or rejection has broader implications for understanding sociopolitical organization at Copán.

The results of this study lead me to pose three questions related to the Harvard Site Typology: (1) *Should some type 2 sites be reclassified as type 3 sites? (2) Should sub-types be created? (3) Is an entirely new classification system needed? (4) Do we need a typology at all?* While these questions cannot be definitively answered at this time, as they depend on which hypotheses are refuted or supported by future archaeological excavations, they nevertheless warrant discussion.

Should some of the type 2 sites be reclassified as type 3 sites?

Several dominant households in the valley are currently designated as type 2 sites (W. Fash 1983a; Leventhal 1979), and archaeologists translate this to mean that they were occupied by commoners. *But why would commoners live at a dominant household?* It seems more likely that someone of high status would have lived at these sites. While such elite may not have been as wealthy as people living at type 3 or 4 sites, the heads of these type 2 dominant households would have held a higher status than people living at non-dominant type 2 sites; therefore, I contend that such sites are misclassified. The data from Zone 3 provide the best example of the conflation of type 2 and 3 sites.

In Zone 3, type 2 sites are slightly more accessible and some have higher visibility than type 3 sites. These data, combined with the fact that archaeologists consider several type 2 sites in this zone to be dominant households, leads me to question their type 2 status. Copán's paired sites exemplify this problem.

Several dominant households are paired, and all are currently classified as type 2, 3, or 4 sites. Two sites, Group 10E-6 in Ostuman and Group 8L-12 in Salamar, are type 4 sites. Four sites, Groups 5O-1 and 5O-8 in Mesa de Petapilla and Groups 11E-2 and 10F-1 in Ostuman are type 3 sites. Ten paired sites are currently classified as non-elite type 2 sites. Both testing and more extensive excavations suggest that the occupants of at least one of these sites had a higher status than currently would be expected using the Harvard Typology.

Group 9P-1, in Titichon, is classified as a type 2 site because it has less than eight mounds, all of which are less than 3 meters high. However, test excavations have uncovered a relatively large number of Copador and Babilonia (Lenca) polychromes (luxury goods) in association with one of the site's stone platforms. In addition, the group's architecture is "imposing" and consists in part of dressed tuff blocks (W. Fash 1983a:125). The presence of luxury goods and high-quality construction materials indicates that the even if the site's occupants were not elite, they had a higher social standing than the inhabitants of the type 2 sites that lacked luxury goods or stone architecture. Test excavations at other type 2 sites reveal similar disparities (Webster et al. 2000), supporting the interpretation that some type 2 sites may be "underclassifed."

One solution is to reclassify type 2 dominant households as type 3 sites; however, I believe the solution is not as simple as that. Instead, I argue for additional research to better delineate the similarities and differences between dominant sites before archaeologists simply reclassify some sites and not others. As discussed, the dichotomy between paired sites may reflect functional, ethnic, and/or temporal differences. Therefore, rather than simply continuing to type sites as elite vs. commoner, it may be more relevant to classify them using other criteria; in other words, it may be useful to create sub-types.

Should sub-types be created?

Currently type 1−4 sites are assumed to be residential in nature, and while excavations at Copán and at other Maya sites suggest that most sites were residential (Webster et al. 2000; Webster and Gonlin 1988), more recent work indicates that some sites had multiple functions or that their functions changed over time (Ashmore 1991; Freter 1994; Plank 2003, 2004). For example, Structure 9N-82 in the suburb of Las Sepulturas has been variously classified as a residence, a lineage monument, a temple, and a domestic structure (Plank 2003:145). I do not disagree with the notion that, generally, speaking Copán's sites were residential in nature; however, I believe that the simple dichotomizing categories of residential vs. non-residential and elite vs. commoner do not accurately reflect the complexity of sociopolitical organization at Copán.

Along these lines, it is commonly believed that late eighth and early ninth century type 3 and 4 sites within the urban core were privately owned by increasingly powerful nonroyal elite (e.g., W. Fash 1983a, 2001; Webster 2001, 2005). Following this line of thought, the access results suggest that the residents of type 3 and 4 sites held administrative, ceremonial, and other positions that directly tied them to the royal court. Recently, however, Shannon Plank (2003, 2004) has posited an alternative explanation for the role that some elite sites played at the end of the Late Classic.

She concludes that *Yax Pasaj,* Copán's last dynastic ruler, actually commissioned the construction/renovation of several *otot* structures, an emic term describing dwellings for important deities and/or ancestors (Structures 9N-82, 9M-146, 8N-66, 9M-194B, and 9M-195B) that were located within urban core elite complexes to serve as sacred transformative spaces where the ruler himself took part in ceremonial rites. Consequently, type 3 and 4 sites (or at least some courtyards within these large complexes) were in actuality part-time public spaces rather than permanent private spaces.

In this scenario, the elaborately sculptured facades and evidence of ritual ceremonies performed by the king do not reflect deliberate actions of nonroyal elites to convey power and assert independence, but instead signify the ruler's attempt to maintain social cohesion. By channeling movement and facilitating ritual processions from the Principal Group to *otot* sites, as evidenced by the high accessibility of these sites, *Yax*

Pasaj extended his reach into the suburbs in an effort at urban renewal (as postulated by Maca and Plank) in an attempt to cope with decentralization (as postulated by W. Fash). This controversy illustrates a need to create sub-types that account for not only functional variation but also emic vs. etic approaches.

In a similar vein, I find the concept of the dominant household intriguing as it connotes that certain households played specialized roles—roles that directly placed their residents in the public arena. Some sites may have been (1) intentionally designed to create a compact, orderly, and formalized design that restricted access and (2) placed in isolated settings to heighten visibility in order to set them apart from other sites and signify their specialized function (rather than simply reflecting a short occupation sequence and a lack of accretion through time). On the one hand, some dominant sites may have served a wider civic role, like that of Group 8L-10 in Salamar; on the other hand, such sites may have been outposts placed in open areas outside of the urban core to oversee hinterland residents—some of whom may have been non-Maya.

Not necessarily related to dominant households, but nevertheless relevant to the discussion of sub-types, is AnnCorrinne Freter's (2004) work in Copán's hinterlands examining variability among sub-communities with respect to economic production. She argues that some sub-communities specialized in production activities, such as plaster, woodworking, and obsidian. Such sub-communities had distinct settlement patterns—and are identifiable non-mound sites located within 100 meters of a type 1 or type 2 residential site. Her work identifies a need for sub-types that account for economic differences between sites. My research results also support the need for sub-types to be added to the Harvard Site Typology.

Is a new classification system needed? Do we need a typology at all?

In the late 1970s, archaeologists developed a trial classification system for sites in the Copán Valley (Willey and Leventhal 1979; Willey et al. 1978). While the typology has proven useful as a heuristic devise for comparing sites, archaeologists are aware of its limitations. Because the typology uses architectural criteria to identify differences in wealth, which archaeologists then translate to signify social status, it offers an etic rather than an emic perspective. In the past 20 years, there has been a shift in archaeology toward more holistic studies that incorporate both top-down (elite) and bottom-up (commoner) approaches, as well as indigenous viewpoints.

Consequently, the Harvard Site Typology's ability to provide a better understanding of indigenous perspectives and incorporate the complex, multi-layered, and cosmopolitan nature of Copán is limited. Despite these limitations, the typology—revolutionary in its time—consists of site types that are useful in their own right as signifiers of economic wealth and have proven useful in addressing certain kinds of questions. So, the questions remain: (1) *Should some type 2 sites be reclassified as type 3 sites? (2) Should sub-types be created? (3) Is an entirely new classification system needed? (4) Do we need a typology at all?* The answer(s) requires future research.

New archaeological, epigraphic, iconographic, architectural, bioarchaeological, and GIS data collected and analyzed since the typology's introduction 30 years ago provide a new framework within which to investigate sociopolitical complexity at Copán. Moreover, the advent of new technologies such as GIS is revolutionizing the practice of archaeology and in fact has allowed me to reveal new patterns suggesting that the Harvard Site Typology does not and cannot account for the internal variation and diversity of ethnicities (Maya and Lenca), social classes, temporalities (Early and Late Classic), and functionalities (public and private at Copán). Although understanding native worldviews and postulating site planning models is not easily done or refuted, my work in analyzing these sites with GIS is helping archaeologists better comprehend ancient political, economic, and social organization at Copán.

Chapter 11:

Broader Significance and Methodological Implications

Broader Significance

Archaeologists traditionally rely on patterns in material culture to understand past societies and their dynamics through time. More recently, and aided by new technologies, archaeologists have increasingly focused on the cultural use of space to enrich understanding of ancient societies. Along these lines, most archaeologists agree that the way in which ancient peoples organized the built environment, their physical surroundings, provides a window to the past. While studies of site organization have been an important part of archaeology for the last half century, it was not until recently that scholars began to regard site layout not simply as a reflection of ancient life, but also as a mechanism that shaped it. Seeking to contribute to the growing body of knowledge about the role site organization played in influencing ancient human behavior, this research investigated the connections between site organization and sociopolitical relations in the late eighth and early ninth centuries at the ancient Maya site of Copán, Honduras.

According to many archaeologists, a site's layout expresses specific ideas about the sociopolitical and ideological systems in which it was constructed (e.g., Ashmore and Sabloff 2002; Blanton 1989; Moore 1996a, 1996b, 2005; Smith 2007). The ancient Maya used various site-planning principles to construct meaningfully arranged structures, monuments, and bounded spaces. The interplay of these elements served to communicate meaning to a site's inhabitants. However, the factors that contribute to a site's architectural forms and arrangements are numerous and their relationships are complex.

Many ancient Maya cities have relatively long, complex political histories resulting in multiple construction episodes. Consequently, many sites were not formed by a single event following an intentional plan; instead, changes through time in sociopolitical, ideological, economic, and environmental context were coupled with changes in the built environment. While the Copán Valley in northwestern Honduras was occupied for over 2,000 years and its civic-ceremonial center is a palimpsest of architectural sequences spanning over 400 years, the long history of research and excavation at Copán provides an opportunity to overcome some of the challenges faced in correlating site organization to social interaction.

This research contributes to studies of ancient site planning by integrating old data with new data and using innovative methods in a theoretical framework of semiotics. According to the theory of semiotics, as applied to architecture and used in archaeology, people configure built forms and bounded spaces in specific ways to send messages to targeted audiences to convey information, shape social interaction, and negotiate political power (Gardin and Peebles 1992; Goffman 1983; Jakobson 1980; Parmentier 1987; Preucel and Bauer 2001). As a result, the spatial configurations of cities are reflections not simply of ancient life but of daily interactions and sociopolitical processes.

While many factors influence ancient social interaction within cities, this research has focused on access and visibility because they are two of the most important factors influencing social connectivity, that is, degree of social integration or segregation, that are recoverable in the archaeological record (Crown and Kohler 1994; Hammond and Tourtellot 1999; Hillier 1999; Hillier and Hanson 1984; Llobera 1996, 2001, 2003, 2006; Stuardo 2003; Tourtellot et al. 2003; Tourtellot et al. 1999). Thinking in semiotic terms, social interaction is a communicative event that involves a*ddressers* (senders of messages) and to *addressees* (receivers of messages) (e.g., Jackobson 1980; Silverstein 1976), and access and visibility provide archaeologists with information on *how* and *to whom* messages were sent. Studies indicate that the accessibility and visibility of buildings, roads, and other features influence how people move about landscapes, and that people make use of this fact by organizing their surroundings to restrict access, channel movement, and display visual messages to elicit distinct responses from different social groups (Hillier 1999; Hillier and Hanson 1984; Llobera 1996, 2001, 2003, 2006). Ultimately, the way in which different groups of people respond to these "signs" influences how different groups of people interact in the landscape.

The study investigated whether or not the Maya living in the ancient city Copán, Honduras, configured their city to facilitate or impede social interaction between people from different social groups and people living in different areas of the city. The research employed Geographic Information Systems (GIS)—a computerized tool that stores, manage, creates, and analyzes attribute and spatial data—to make quantifiable observations about social connectivity using access and visibility as proxy measures for social interaction. In order to determine if patterns of social connectivity were replicated across society, I employed a multi-scalar approach. The results indicate that Copán's layout served as a guide to daily interactions, potentially channeling people from particular social classes to specific locations and sending visual messages of wealth, power, and surveillance to certain groups of people and particular locations in the city. My work also revealed unexpected spatial patterns that raise new questions about

Copán's sociopolitical organization and its traditional classification of sites (known as the Harvard Site Typology).

I addressed two main research questions: (1) *Did people of different social classes experience different degrees of social connectivity?* and (2) *Did people living in different parts of the city experience different degrees of social connectivity?* While the first question investigated the degree to which people of different social classes were integrated or segregated within society as a whole, the second question examined whether patterns of social connectivity were replicated across different scales of society and helped to address an ongoing debate about the nature and degree of social replication in ancient Maya societies—a debate that is particularly pertinent at Copán, where questions of social organization (segmentary lineage vs. stratified society) and ethnic diversity abound (e.g., W. Fash 1983a, 1983b; Freter 2004; Gonlin 1994; Maca 2009; Manahan 2004; Manahan and Canuto 2009; Sanders 1989; Webster 2002, 2005).

The debate centers on whether social organization is replicated at smaller and larger scales in society, for example, elite forms being replicated in smaller-scale, non-elite forms, or urban forms being replicated in hinterland forms, and the answer to this question affects interpretations about the nature of sociopolitical organization and sociopolitical control ("weak" vs. centralized political state) in the late eighth and early ninth centuries. Ultimately, the two questions are inextricably linked, and the answer to the first question is dependent upon the answer to the second question.

To address these questions, I measured social connectivity at four analytical scales (valley-wide, physiographic zone, urban core−hinterlands, and sub-communities). The results indicate that Copán's elite had greater access to and stronger visual ties to the city's main civic-ceremonial group, the Principal Group, than did commoners. The multi-scalar approach revealed some underlying complexities of sociopolitical organization, showing that spatial and visual hierarchies were not replicated across the valley. In the urban core and the eastern part of the valley elite complexes were more accessible and visually prominent than commoner households. These data indicate that the elite living in these areas of the valley had higher degrees of social connectivity than did commoners; in other words, they lived in locations that made them more integrated with society as a whole and afforded them greater sociopolitical control.

Although the urban core and eastern part of the valley had similar spatial and visual hierarchies, the differences in the degree of social connectivity between elite and commoner sites were much greater in the urban core. The urban elite had a high degree of social connectivity, suggesting that they exercised a greater degree of sociopolitical control than did elite living in eastern hinterland sub-communities, who had a moderate degree of social connectivity. In contrast, the access and visibility data indicate low degrees of social connectivity and minimal sociopolitical control in the western part of the valley. The results suggest that three intermediate-level interaction spheres existed in the late eighth and early ninth centuries at Copán (see Figure 10.2).

Thus, while higher accessibility and visibility are correlated to higher social status in some interaction spheres, the exceptions to this pattern offer some evidence that social organization may not be replicated at all societal levels. In other words, non-elite forms may not be replications of elite forms, or at the very least urban forms are not replicated in hinterland forms. This result has implications for the debate about the nature of sociopolitical organization at Copán, because it suggests a greater degree of social stratification or differences among the many layers of society, than is ascribed in the segmentary lineage model (Sanders 1989).

In conclusion, the access and visibility patterns suggest that Copán's spatial organization helped to produce and maintain the society's hierarchical social structure in areas with longer occupation sequences and higher settlement densities, that is, in the central and eastern parts of the valley. In other words, the city's layout, in effect, replicated and reinforced society's hierarchical class structure. The elite in these areas placed themselves in accessible and elevated positions that afforded them greater sociopolitical control and sent messages letting lower-status individuals know that they were "watching over" them—just as the king watched over them and the deities watched over the king. By directing pedestrian movement and establishing visual connections among people living at distinct site types, the elite were able to communicate information that helped to integrate some groups of people and segregate others and affect levels of sociopolitical control at Copán. In doing so they sent messages of authority and power and, I would argue, effectively linking social order to cosmic order by reminding people of their proper place in the cosmos in which supernatural beings and lords were separated from lesser or lower beings (although the links among access, visibility, and cosmology require further investigation).

Methodological Implications

While there are a variety of approaches to studying the built environment (Lawrence and Low 1990), scholars have criticized many of them for their lack of explicit assumptions and rigorous empirical methods (e.g., M. Smith 2003, 2007). This critique is especially relevant to studies of ancient site planning (Ashmore and Sabloff 2002, 2003; Blanton 1989; M. Smith 2003, 2007). My research addresses these criticisms in two ways. First, rather than trying to incorporate all possible site-planning principles (and overextending the analysis), I focus explicitly on two site-planning principles, access and visibility, to study the relationship between site configuration and social connectivity. In this way, my approach offers a set of explicit assumptions about the links between two specific aspects of site planning and the roles they play in structuring sociopolitical organization in ancient societies. Second, I offer an innovative methodology that takes advantages of the unique capabilities of GIS.

In a recent article in the *Journal of Planning History*, Michael Smith (2007) presents a new model for studying and interpreting urban planning in ancient cities. He organizes the model into two broad categories: (1) the coordinated arrangement of buildings and spaces and (2) standardization. While factors such as simple coordination, formality and monumentality of layout, orthogonality, other forms of geometric order, and access and visibility reflect coordination, data on urban architectural inventories, spatial layouts, orientation, and metrology inform on standardization. Smith argues that these factors are best interpreted using Rapoport's (1988) three levels of meaning in the built environment, which take into account cosmology (high-level meaning), messages about power, identity, and status (middle-level meaning), and the built environment's role in manipulating movement and shaping behavior (low-level meaning). I reference Smith's work because I believe that the separation of site planning principles into discrete categories for analytical purposes is essential for developing systematic studies of ancient planning.

To this end, I have limited the scope of my research to access and visibility, factors that directly examine movement and the shaping of behavior (Rapoport's lowest level of meaning), yet also provide information on middle- and high-level meanings. By limiting the analysis to two specific site-planning principles, I was able to concentrate my efforts on developing a sound methodology that takes advantage of recent technological advancements, specifically in the field of GIS. The goal was to develop a basic set of GIS-based methods that could be built upon and expanded to incorporate additional factors that influence site planning, such as formality and monumentality of layout, orthogonality, and orientation. In this way, researchers can work independently to develop the individual components of a more holistic step-by-step methodology that rigorously analyzes the various aspects of site planning using standardized techniques.

While traditional methods of studying access and visibility have proven useful and provided insight into ancient social interaction (e.g., Bustard 1996; Ferguson 1996; Shapiro 2005; Stuardo 2003; Vogrin 1989), they exhibit several shortcomings, many of which can be overcome using GIS. In the case of ancient Maya sites, previous studies have focused on ceremonial precincts or individual elite compounds and therefore fail to account for how groups of people from different social classes may have interacted. Moreover, they tend to investigate single and smaller scales of analysis such as individual households and architectural complexes rather than using a multi-scalar approach that crosses boundaries and moves from single households, to multi-family architectural complexes, to neighborhoods, and up to the scale of the city itself.

Additionally, both access and visibility studies typically rely on simple longest-line-of-sight mapping derived from planimetric (2D) representations (Batty 2004; Ratti

2004, 2005), which may be sufficient for measuring interior spaces for buildings or even architectural compounds; however, such representations cannot accurately measure access and visibility across landscapes. They are not appropriate for measuring access because they do not take into account distance, topography, or the effects of barriers and facilitators on movement in the landscape. Movement across landscapes does not typically occur on flat surfaces devoid of features, but rather up and down hills, across rivers, and along roads, which facilitate or impede movement. Thus, longest-line-of-sight mapping is not adequate for measuring access; instead, an alternative approach that takes into account the cost of movement is more appropriate. Such simple mapping is also not appropriate for evaluating visibility (across landscapes) because it only measures intervisibility between two objects and fails to account for the relationships that an object may have to the many objects or features in the landscape (Llobera 2006). In other words, it cannot identify structure or patterning of visual space, which can help archaeologists to recognize boundaries between social groups, cultural groupings, and activity areas (Llobera 2003).

Finally, current approaches to access and visibility only take into account either the built environment or the natural landscape. However, because Maya cities are comprise both the built and natural environments (the *kahkab*), it is critical to include both of these components in access and visibility studies (Ashmore 2004; Marcus 2000). For example, along the Usumacinta River in Guatemala, the ancient Maya constructed temples atop caves that during the wet season were filled with fast-flowing water that echoed a roaring sound up through the structures (Brady and Ashmore 1999). By fusing their built and natural surroundings, they were able to create an auditory effect that produced a ritually charged atmosphere at specific times of the year. In another example, the inhabitants of Copán used the natural backdrop of the hillsides to "heighten" certain ceremonial and/or elite structures, making them appear larger than they truly were (Leventhal 1979, 1983).

A GIS proved to be an ideal solution for each of these problems because of its ability to (1) transform old maps and architectural drawings from analog to digital data, (2) georeference (assign real-world coordinate information) digitized datasets, (3) overlay multiple layers, such as sites, monuments, hydrology, and topography, (4) convert vector (discrete) data to raster data (pixels with values), and (5) link attributes, such as height, distance, and elevation, to spatial data. Additionally, the GIS contained a set of tools that allowed me to integrate the built environment and natural landscape into a single format (an Urban DEM), perform quantitative analyses, and study complex spatial relationships.

However, there are some limitations to the methods and consequently to the research. First, to study site configuration as whole requires a 100% ground survey of archaeological sites (structures). For small sites this is typically not a problem, but for large sites such surveys are often cost-prohibitive. However, with recent advances in remote sensing (e.g., Saturno et al. 2006; Saturno et al. 2007), even heavily canopied sites such as those located in the southern Maya lowlands are beginning to be mapped via aerial and satellite imagery, thus making full-coverage survey a more reasonable technique.

Second, to study changes through time requires diachronic information that is typically not available across entire sites. Thus, while the methods are not limited to synchronic studies, the nature of archaeological research (archaeologists do not typically excavate entire sites) limits the ability to use the method to study changes in social connectivity through time. However, at single-component sites or sites such as Copán where researchers have good chronological control for surface remains, the methods are ideal for studying social connectivity in specific time periods. Moreover, the methods can be used to investigate changes in social connectivity across time by comparing sites from distinct time periods, for example, Early Classic to Late Maya Classic sites.

Third, one of the major advantages of working at Copán was the Harvard Site Typology. Despite some of its limitations, the typology proved to be effective (according to the access and visibility results) in delineating differences between all site types except for type 2 and type 3 sites. In order to investigate social connectivity between people of different social groups, archaeologists need to have an understanding of the relationship between sites (architecture) and social class, that is, they need some way to delineate social class whether it be via a typology or not. Fortunately, the method is not limited, in this way, in its ability to examine social connectivity between different areas of archaeological sites.

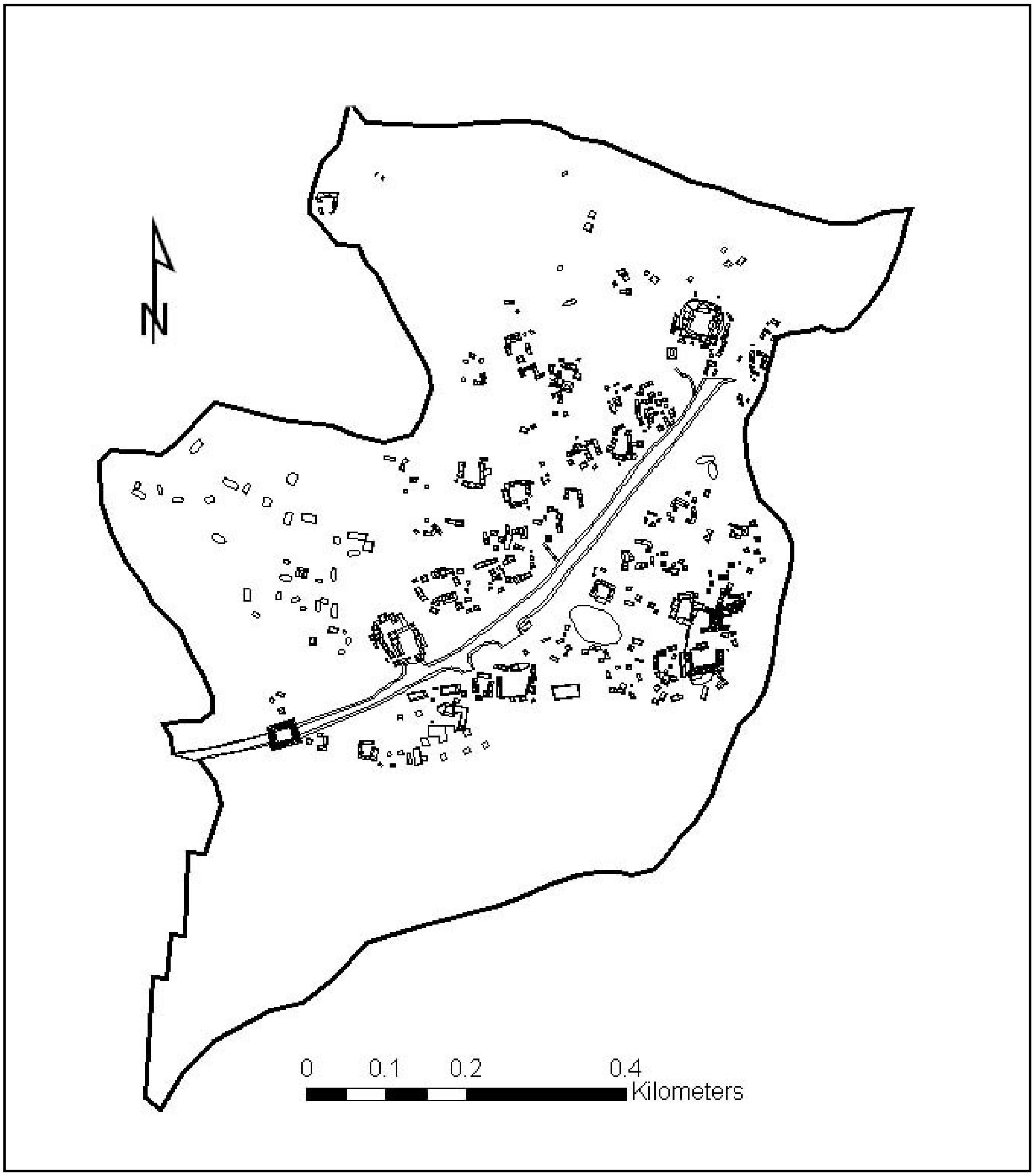
Fourth, the method cannot account for unidentified social norms such as gender, age, or sex that may prohibit people, despite social class, from entering certain spaces or interacting with specific people (or groups of people). It is possible to enter data on social norms (most likely obtained from ethnographic studies) into a GIS and classify these data to in some way reflect ancient restrictions on the use of space; however, such an approach requires not only adequate data on social norms but also an empirical technique to translate these data from qualitative to quantitative categories.

Given these limitations, I view the methodology used in this study as a step in developing a comprehensive, standardized approach to studying ancient site planning, the following list offers some ways to build on and improve this research's methods for future projects at Copán and other archaeological sites.

1. Develop new measures and analytical tools to integrate indigenous perspectives
2. Incorporate additional attributes, e.g., ceramic types, burials, iconography, hieroglyphs, etc., into the analyses
3. Include variation in building type, e.g., three-part, two-part, internally connected vs. non-internally connected, U-shaped, etc.
4. Overlap least-cost paths with viewsheds to identify different types of paths, e.g., hidden vs. visible, and their functions
5. Model construction phases for Acropolis and multi-component sites to investigate changes through time in access and visibility
6. Measure intra−sub-community access and visibility (beyond dominant households) to investigate the distinct and perhaps unique roles of individual sub-communities, e.g., overseeing agricultural and other forms of production
7. Use an alternative approach to investigate the lack of statistical differences in some of the visibility data. That is, randomly assign "site" locations within each sub-community (use same number and type of sites as currently recorded), conduct the same visibility analysis used for original data, and compare the results of the actual site locations and random locations. If the results for the two datasets are different, then meaningful patterns can be attributed to socio-cultural decisions on the part of the ancient Copanecos.
8. Develop a measure that combines access and visibility values

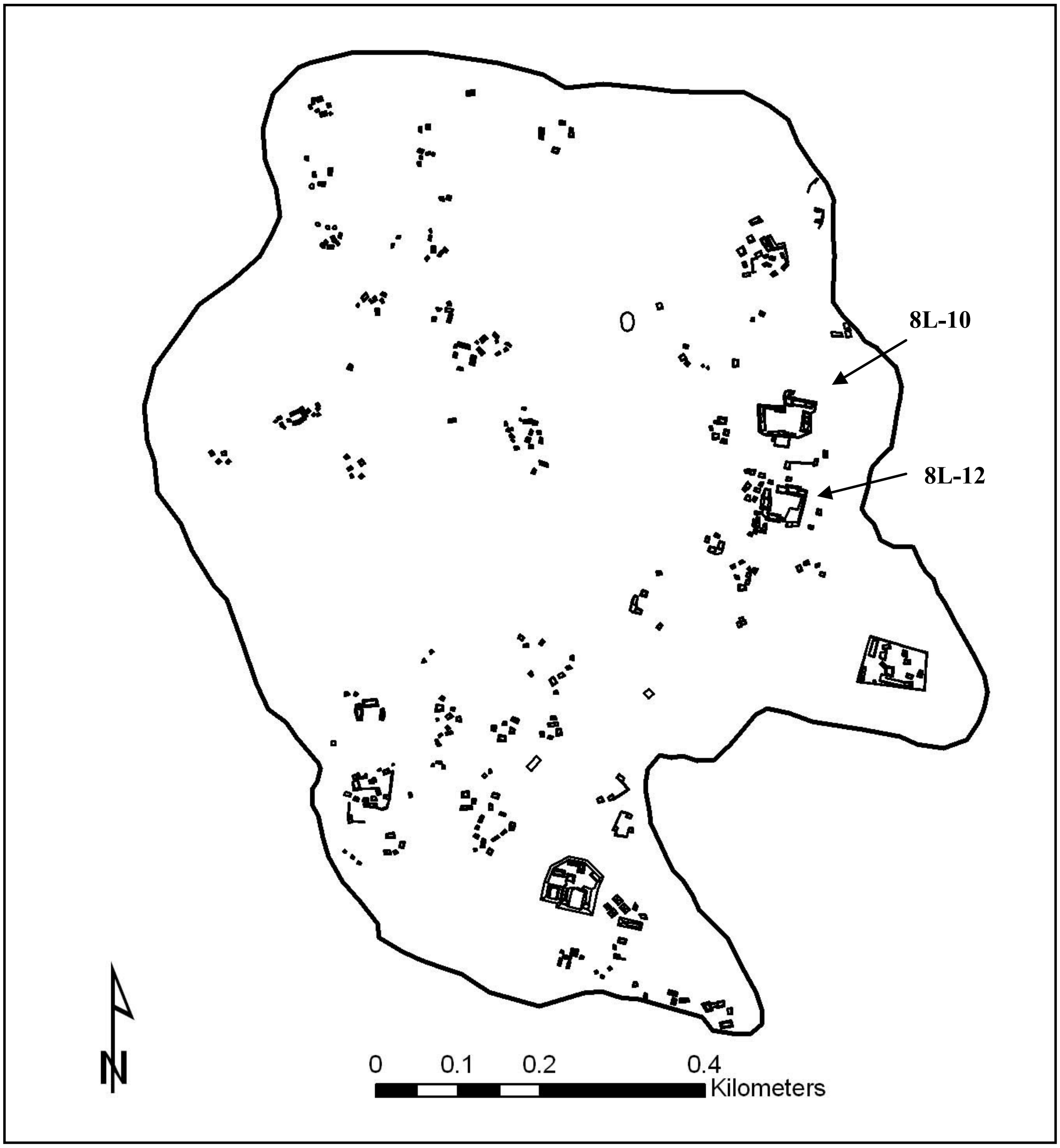
While the methodology developed for this study can be improved (like all methods), it provides solutions to many of the limitations of earlier access and visibility approaches. Its ability to quantitatively measure social connectivity at ancient sites revealed unexpected spatial relations that raise new questions about Copán's social organization and its traditional classification of sites (the Harvard Site Typology). These new questions, in turn, resulted in a set of testable hypotheses (listed in Chapter 10) that can be investigated using GIS and more traditional archaeological methods such as excavation. With respect to other Maya sites, the methodology can be used to compare and contrast Maya sites from different regions as well as from different time periods (Preclassic, Early Classic, Late Classic, and Postclassic). In addition, it can be used to compare Maya sites to non-Maya sites to improve our understanding of the possible influence of regional and ethnic diversity on site and social organization—issues that are relevant beyond Copán (e.g., Demarest 1996; Maca 2009). Finally, the method is not limited to ancient Maya sites but can be applied to study social connectivity and social organization at archaeological sites from many cultures throughout the world.

Appendix A: GIS Maps of Copán's *Sian Otots*

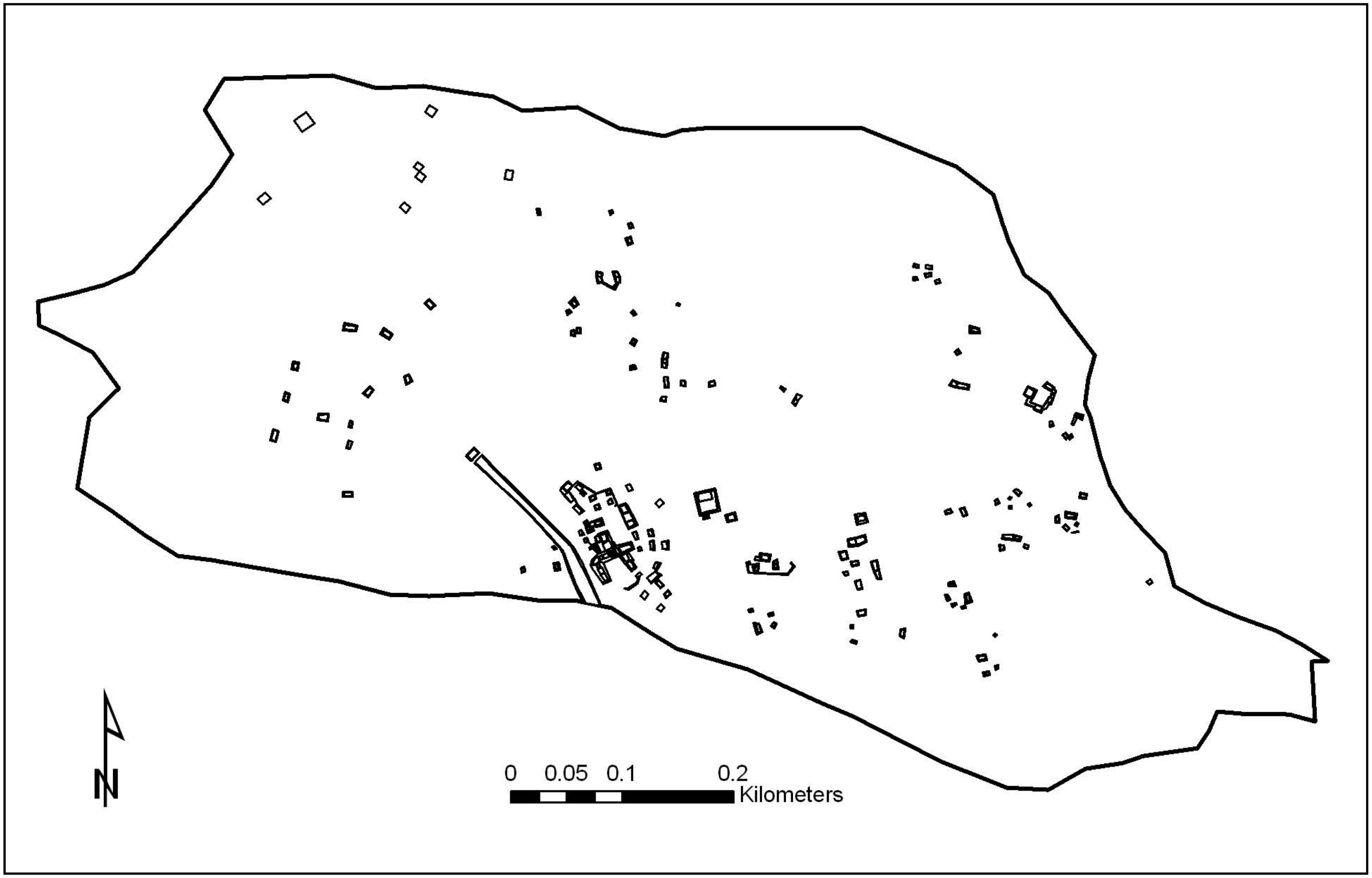


Map A.1: GIS map of Las Sepulturas *sian otot* (Richards-Rissetto 2008)

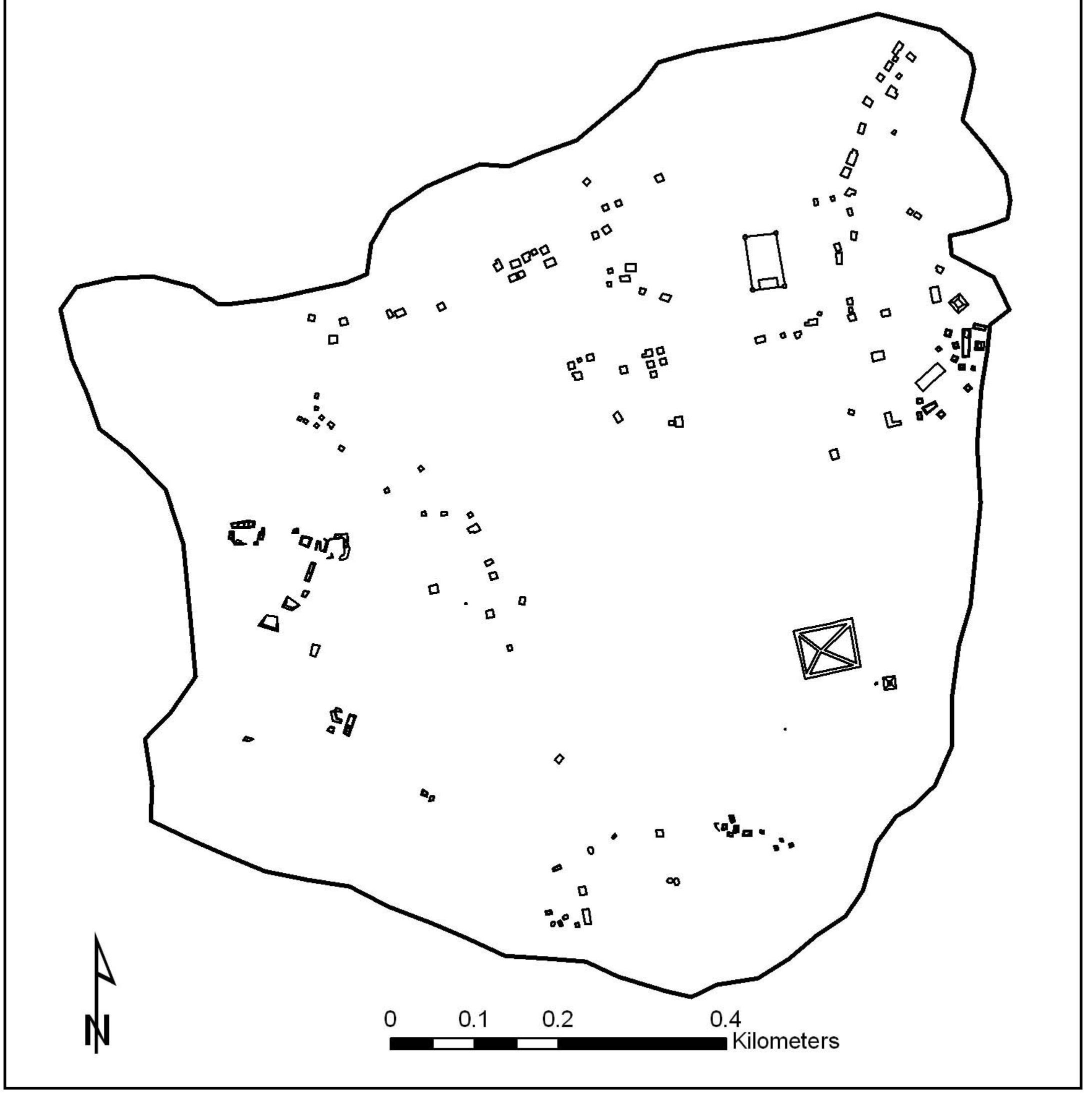
Map A.2 : GIS map of El Bosque *sian otot* (Richards-Rissetto 2008)



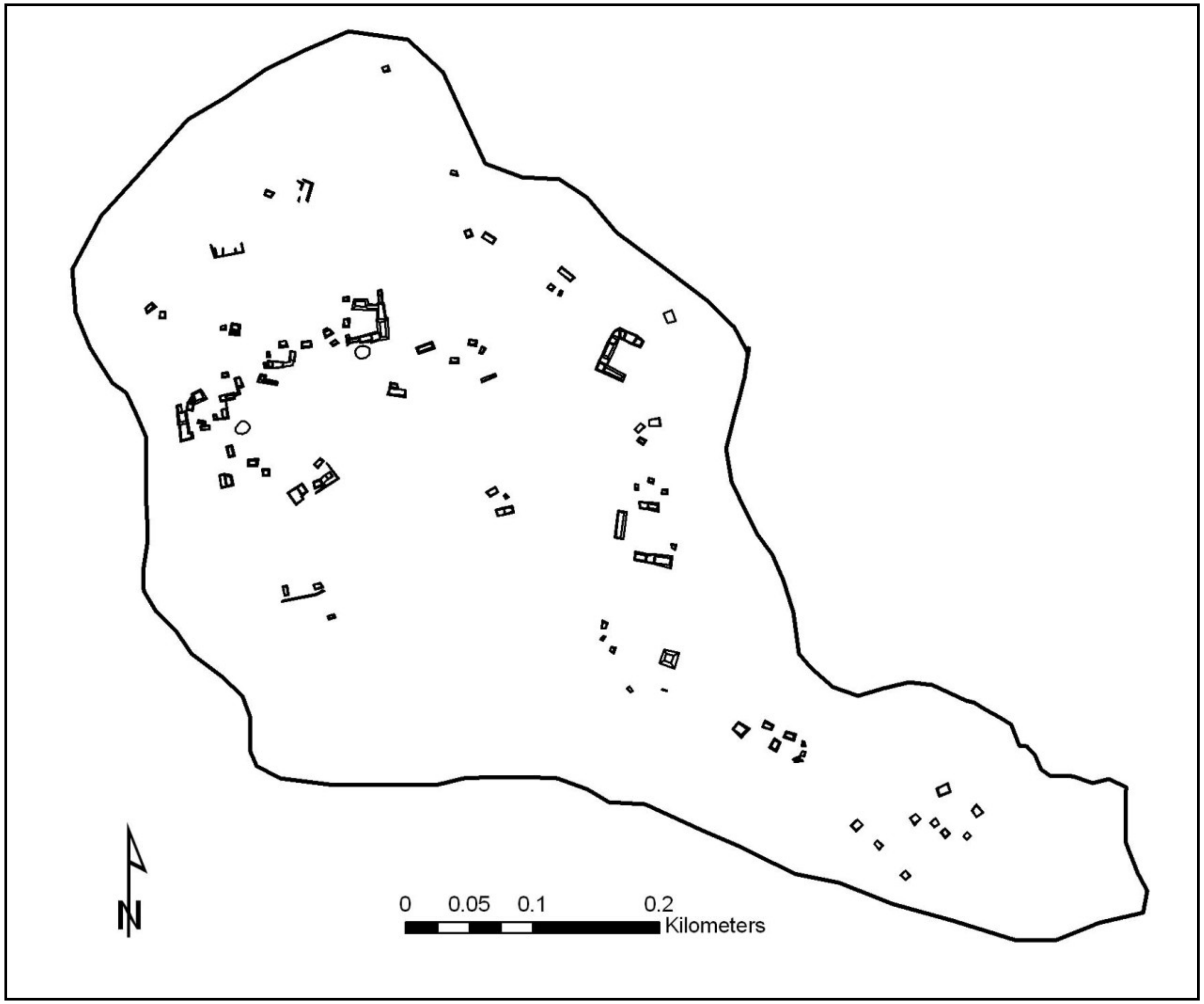
Map A.3 : GIS map of Salamar *sian otot* (Richards-Rissetto 2008)



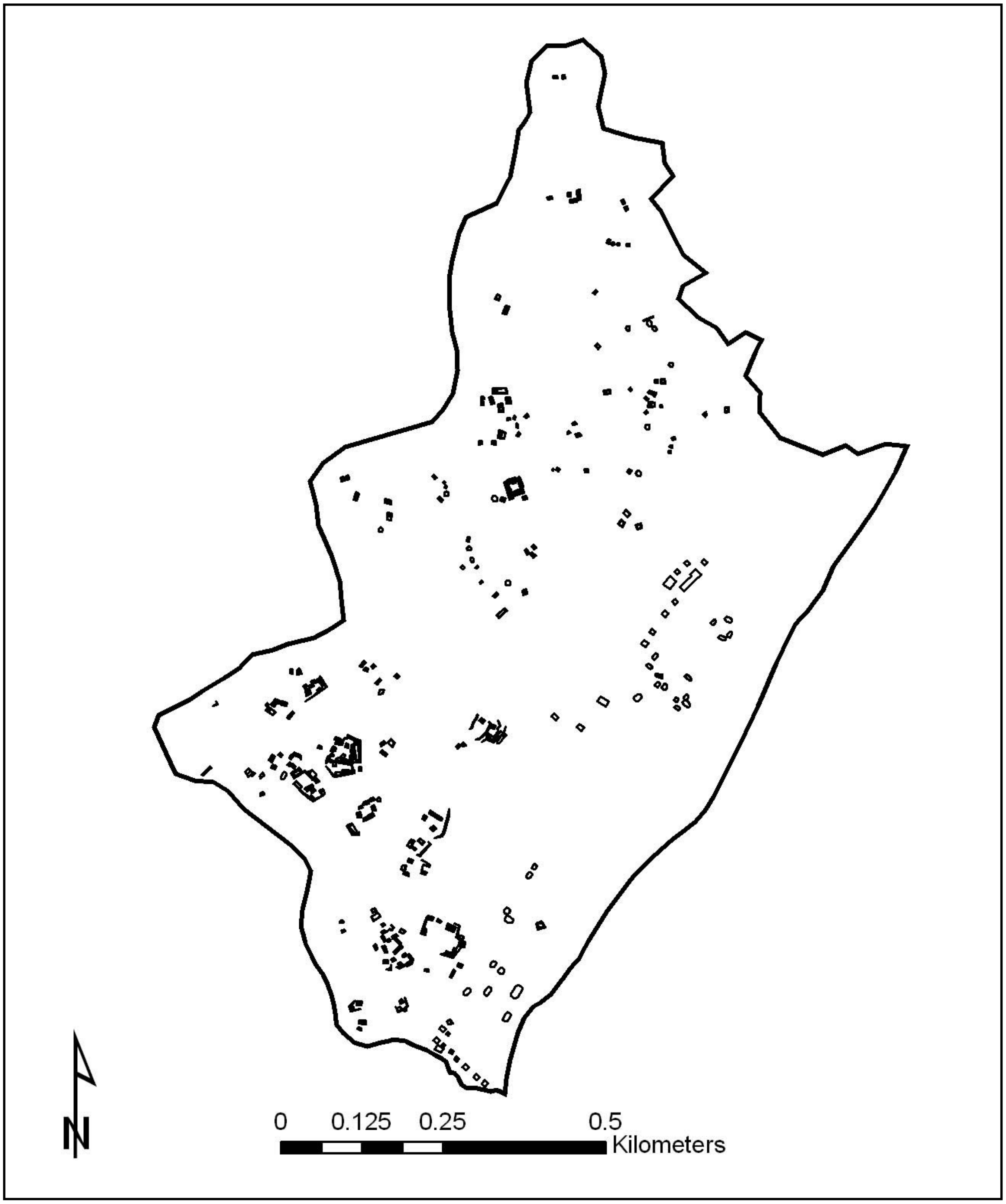
Map A.4: GIS map of Comedero *sian otot* (Richards-Rissetto 2008)



Map A.5: GIS map of El Pueblo *sian otot* (Richards-Rissetto 2008)



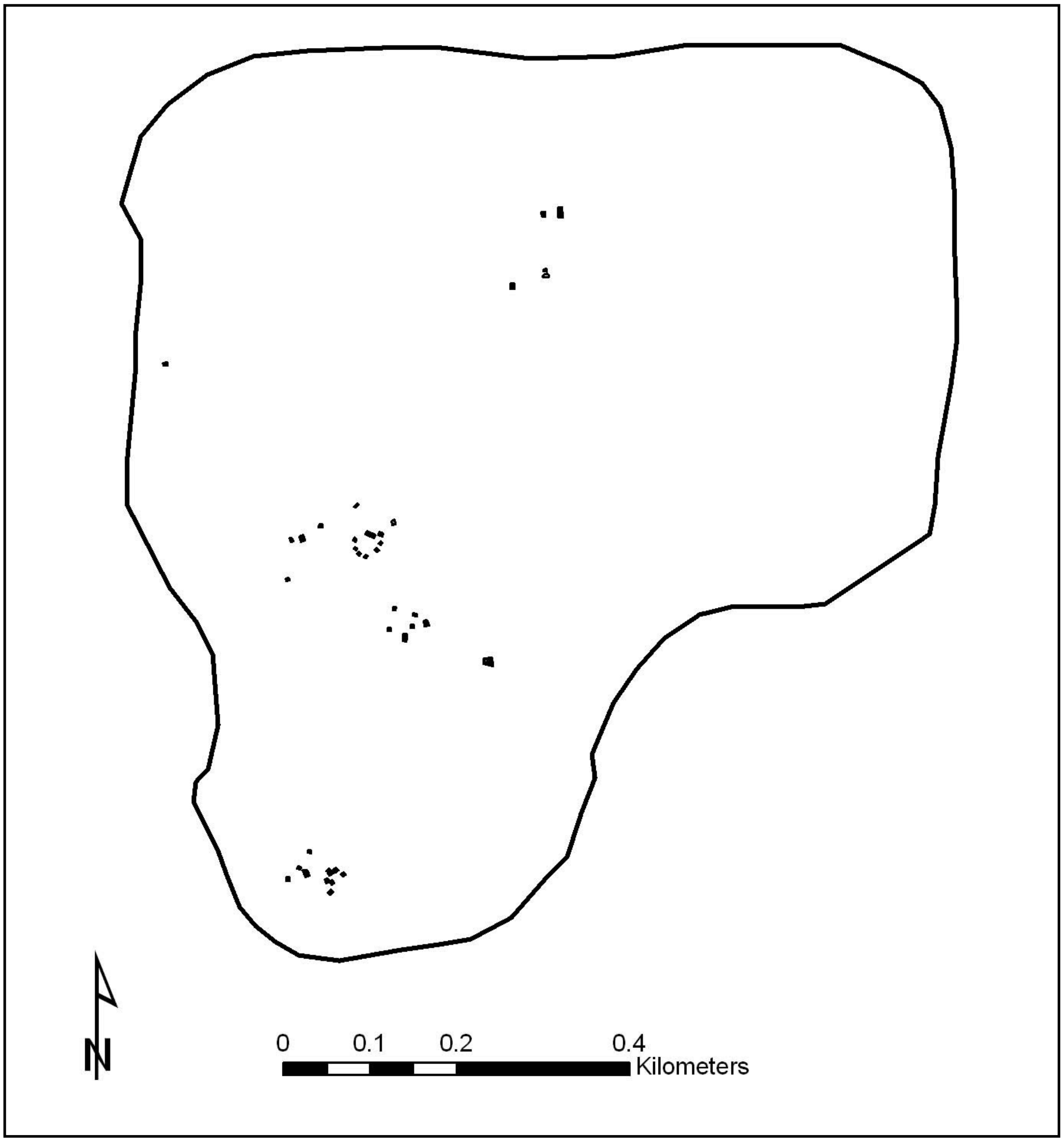
Map A.6: GIS map of Chorro *sian otot* (Richards-Rissetto 2008)



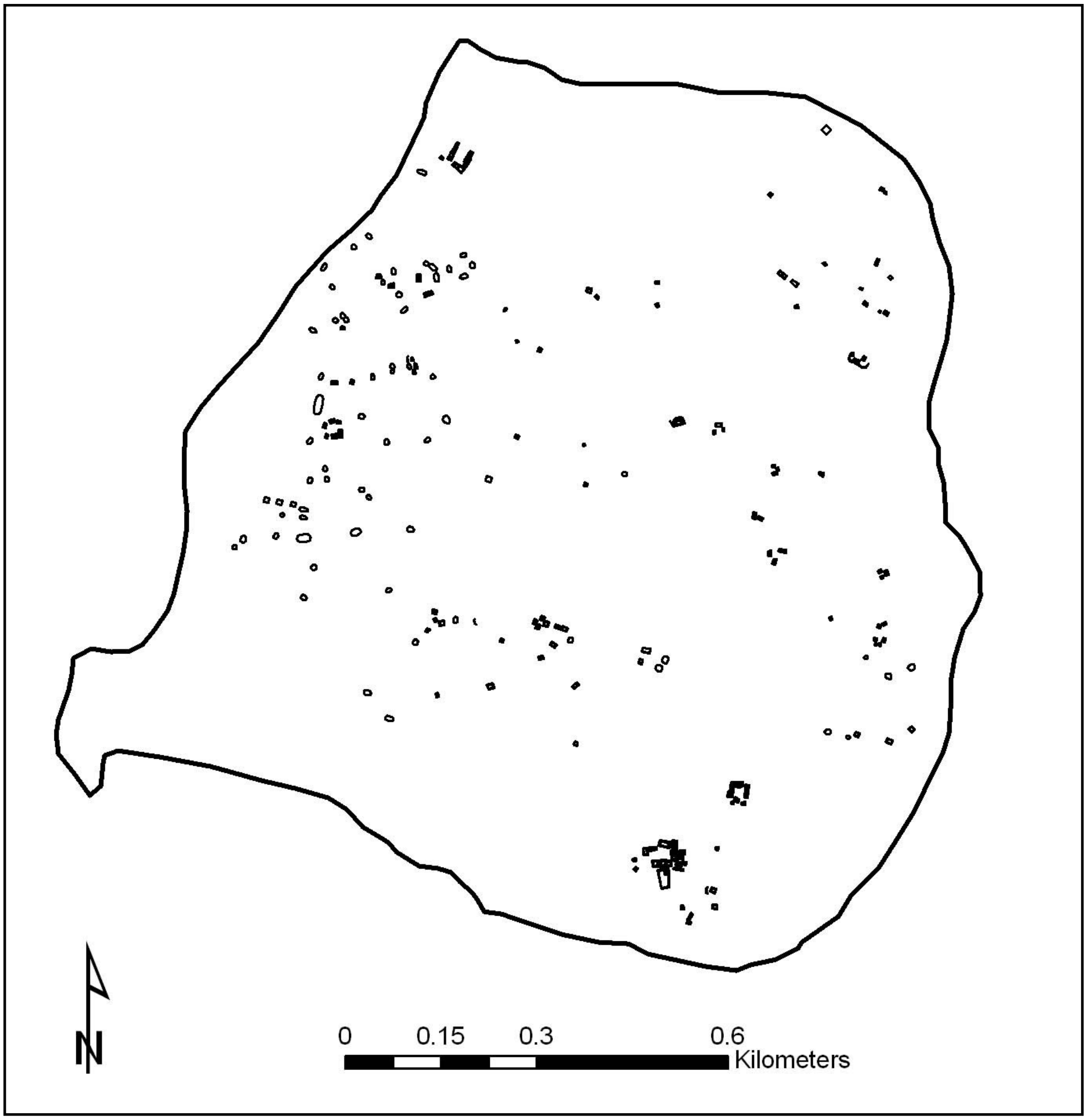
Map A.7: GIS map of Rastrojon *sian otot* (Richards-Rissetto 2008)

Map A.8: GIS map of Mesa de Petapilla *sian otot* (Richards-Rissetto 2008)

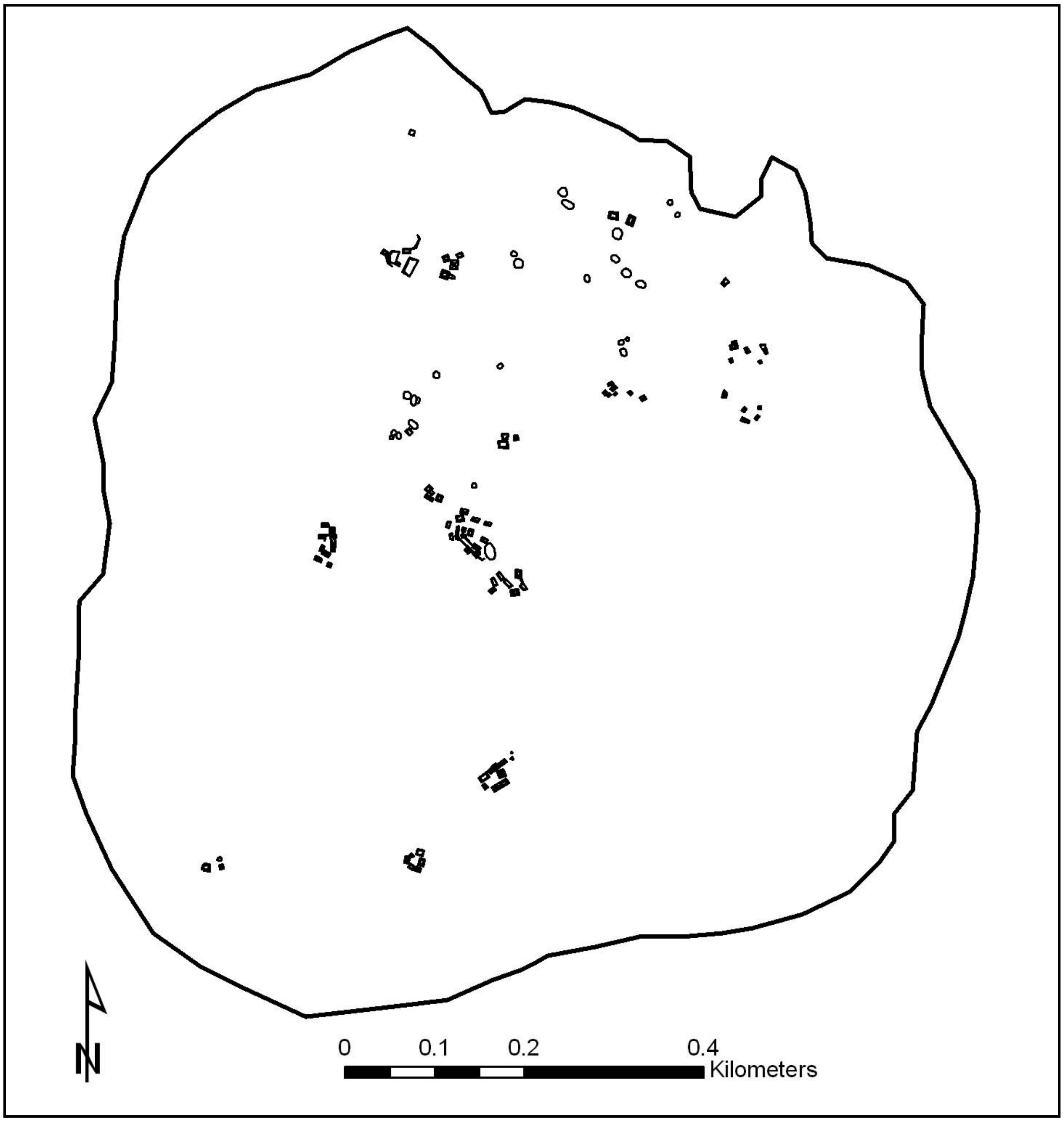
Map A.9: GIS map of Bolsa de Petapilla *sian otot* (Richards-Rissetto 2008)



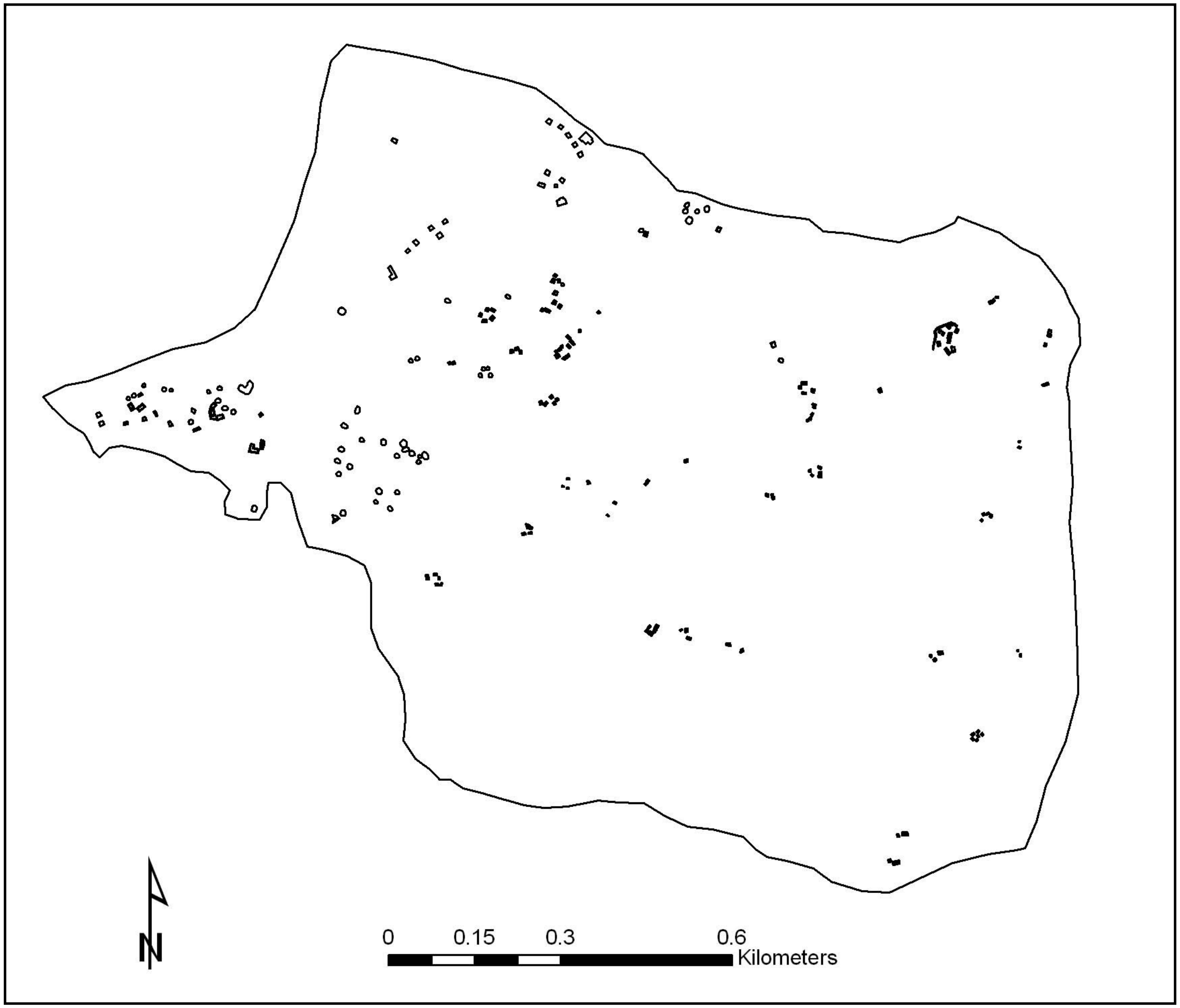
Map A.10: GIS map of Titoror *sian otot* (Richards-Rissetto 2008)



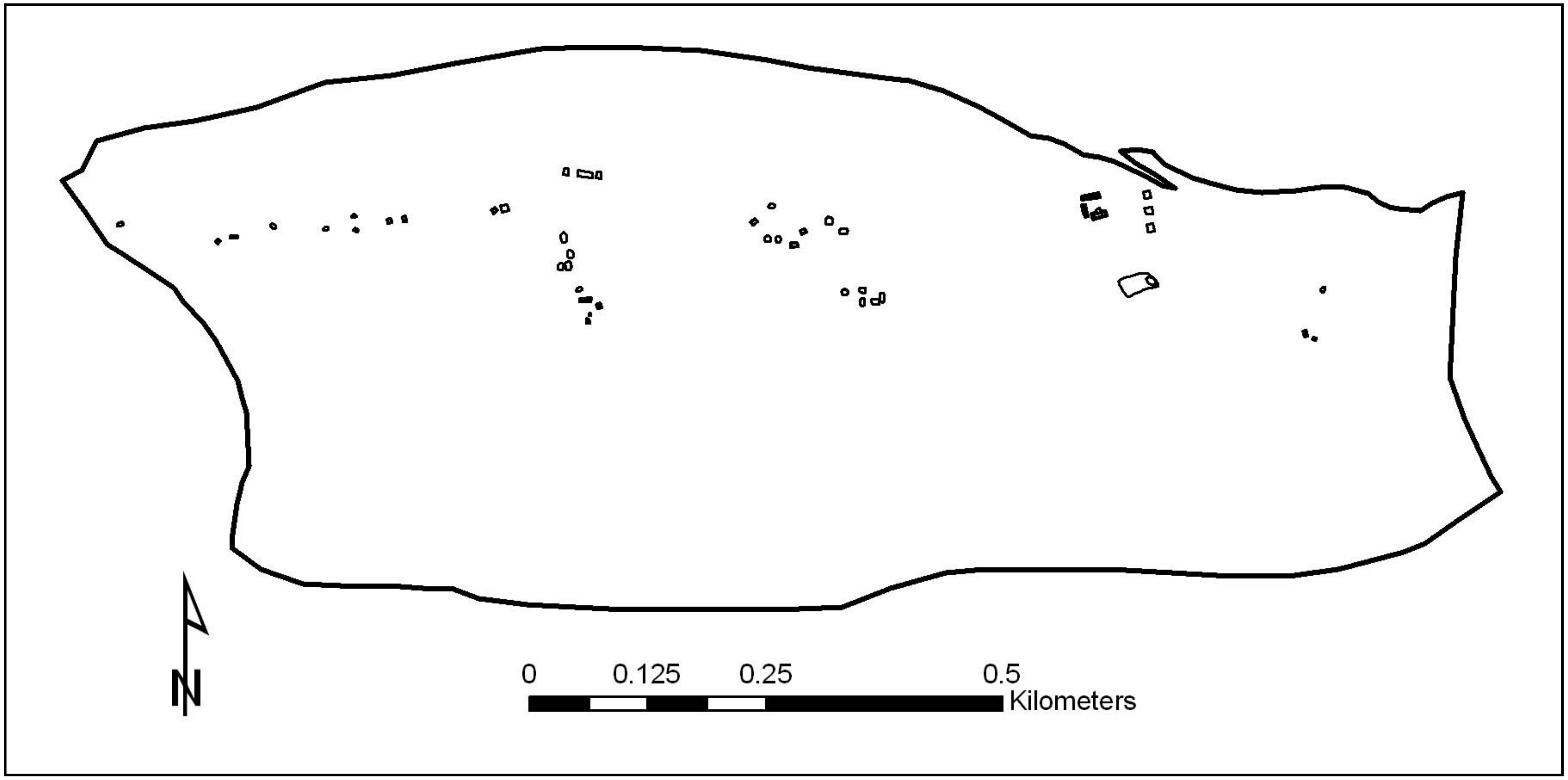
Map A.11: GIS map of Titichon *sian otot* (Richards-Rissetto 2008)



Map A.12: GIS map of San Lucas *sian otot* (Richards-Rissetto 2008)

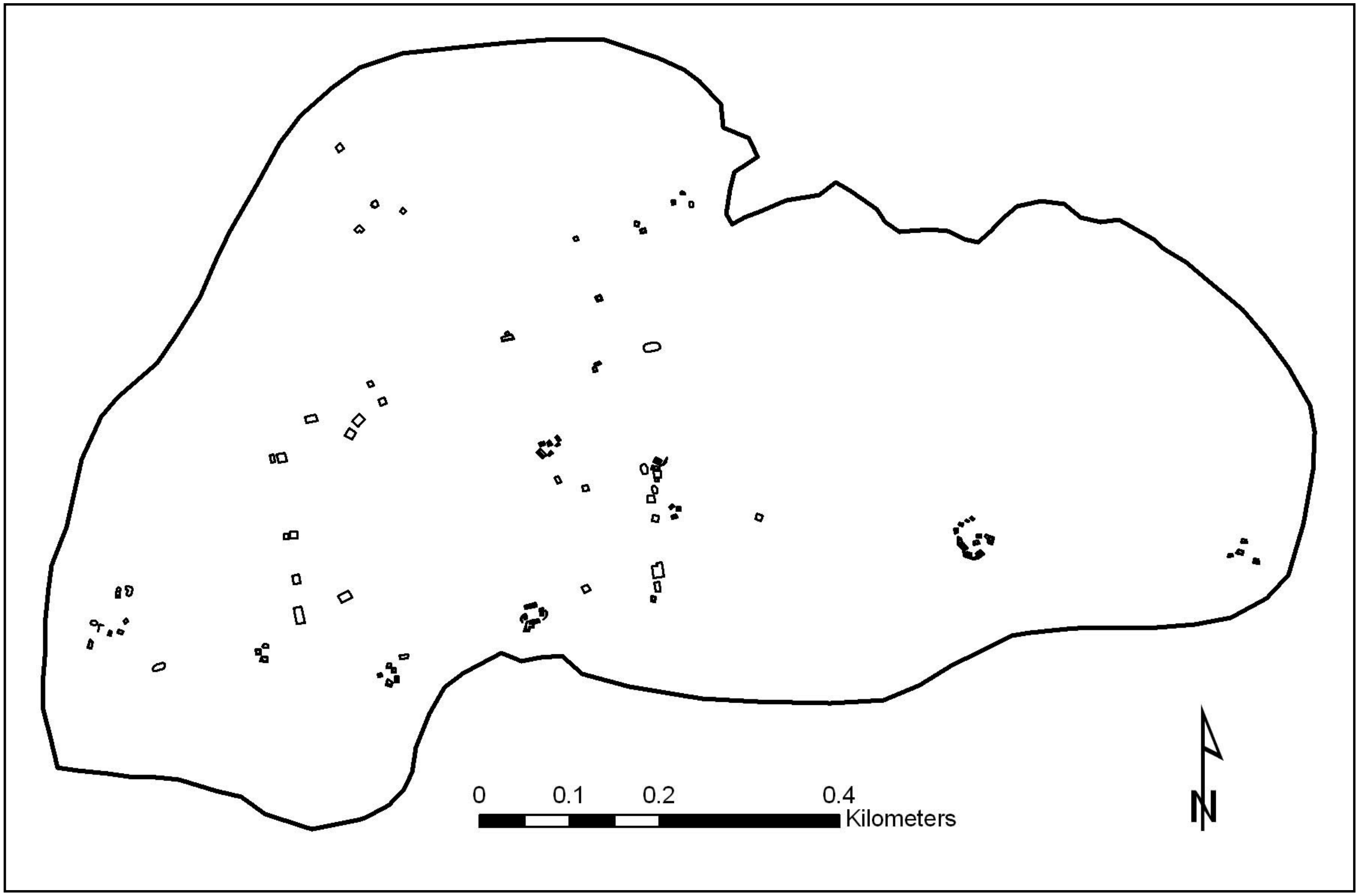


Map A.13: GIS map of San Rafael *sian otot* (Richards-Rissetto 2008)

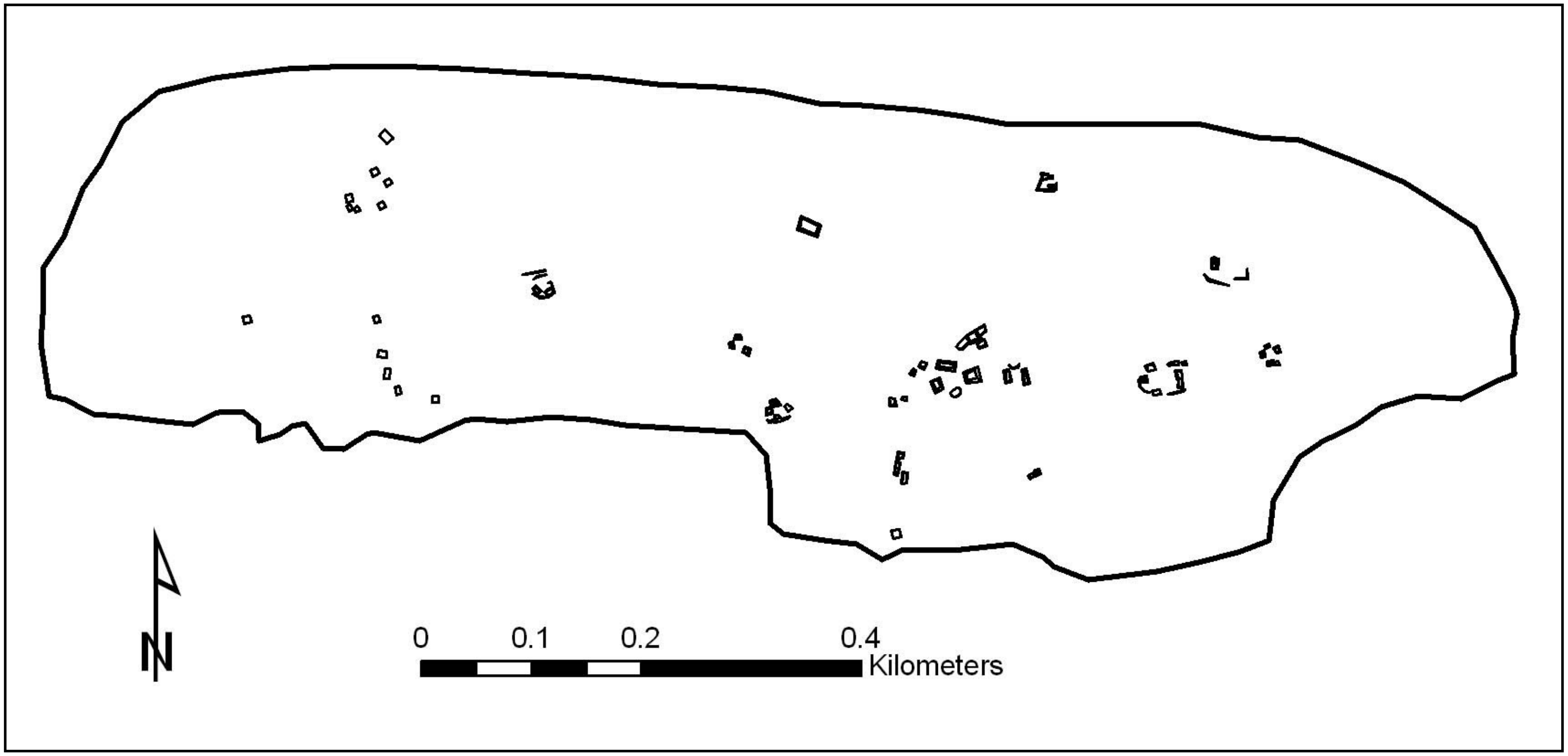


Map A.14: GIS map of El Puente *sian otot* (Richards-Rissetto 2008)

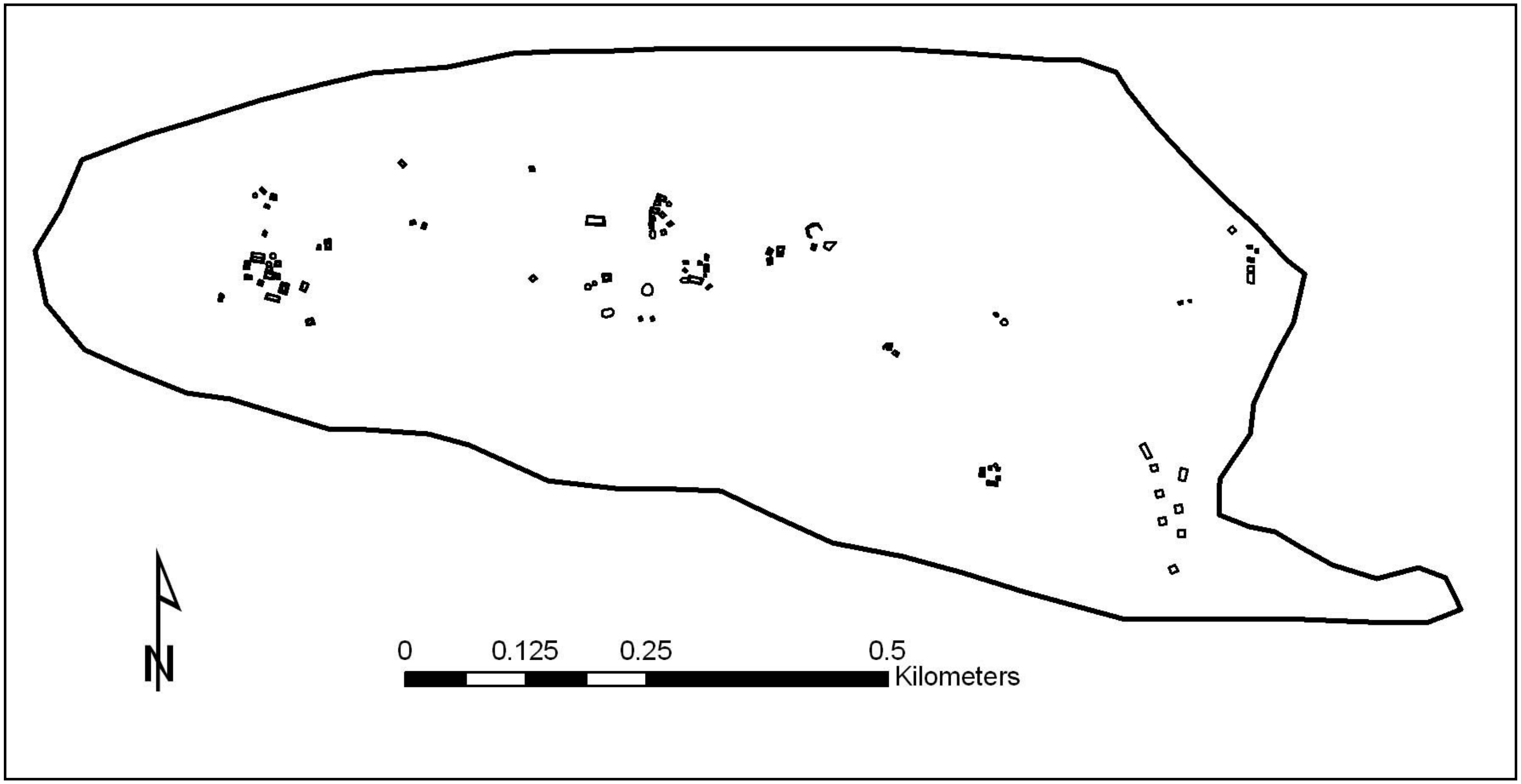
Map A.15: GIS map of Ostuman *sian otot* (Richards-Rissetto 2008)



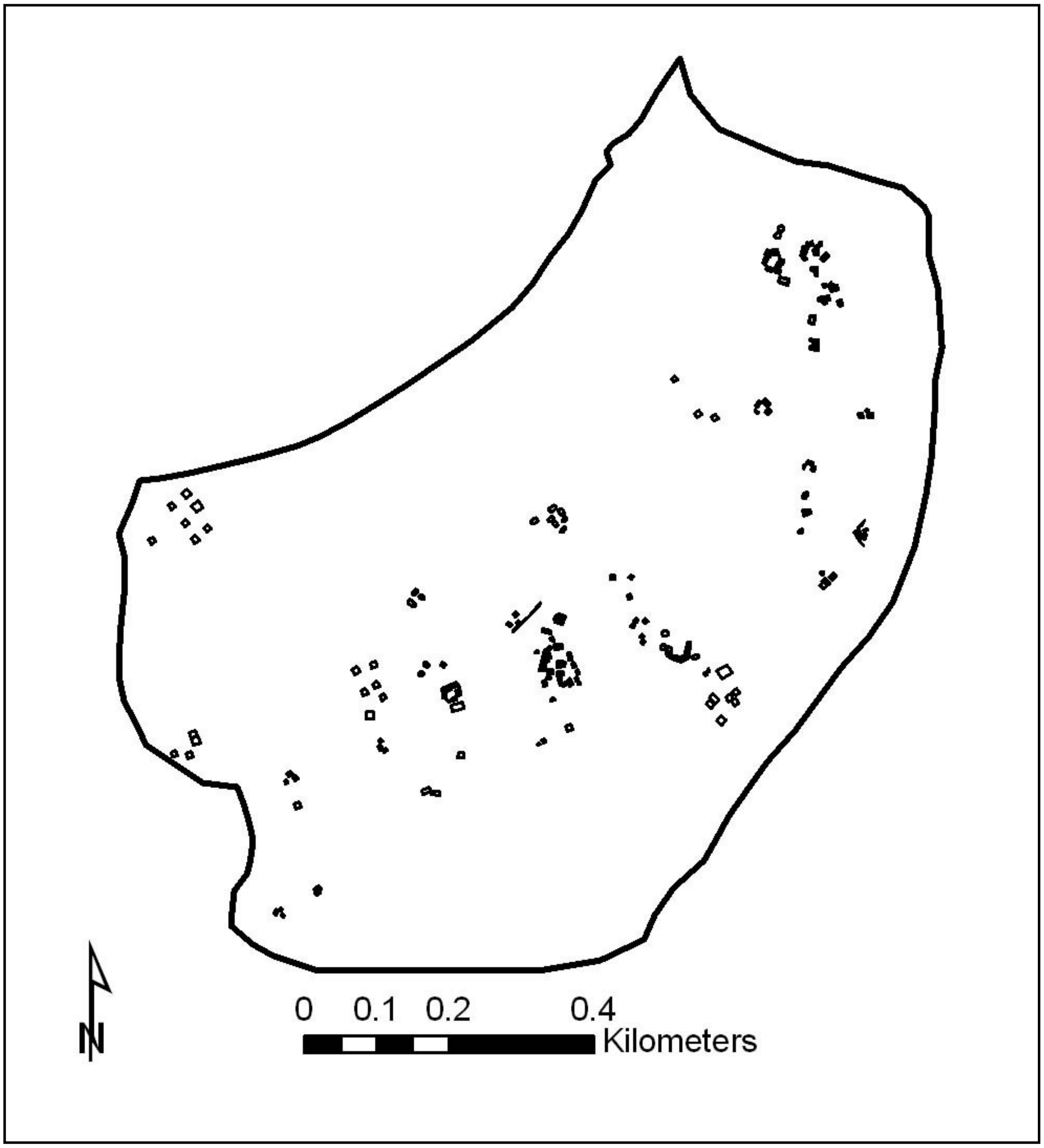
Map A.16: GIS map of Rincon del Buey *sian otot* (Richards-Rissetto 2008)



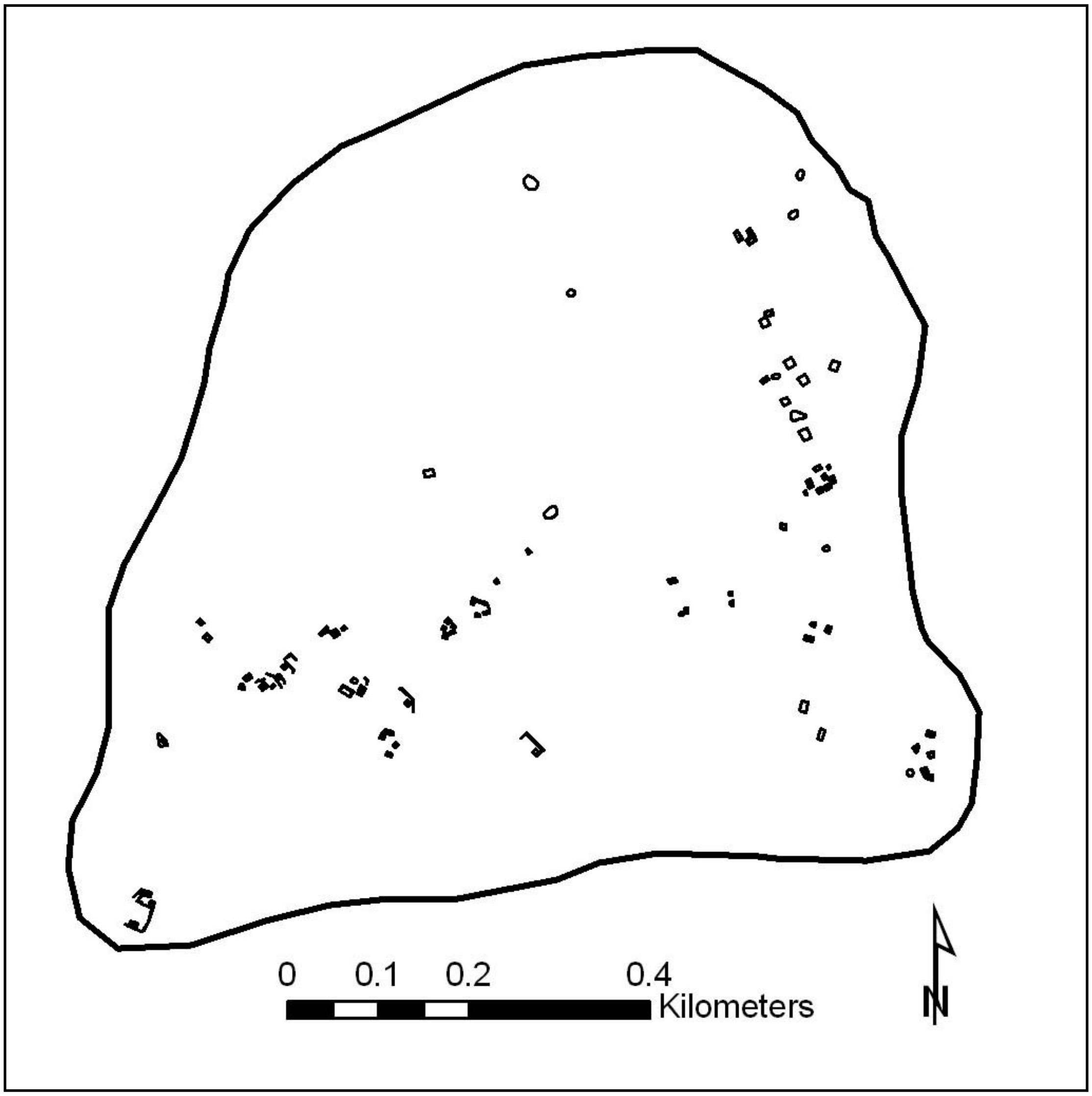
Map A.17: GIS map of Yaragua *sian otot* (Richards-Rissetto 2008)



Map A.18: **GIS map of Algodonal *sian otot* (Richards-Rissetto 2008)**



Map A.19: GIS map of Estanzuela *sian otot* (Richards-Rissetto 2008)



Map A.20: GIS map of Tapescos *sian otot* (Richards-Rissetto 2008)

The sources for the GIS data include: (1) *Proyecto Arqueológico Copán* (PAC I) maps (Fash and Long 1983), (2) *Proyecto Arqueológico para la Planificacion de la Antigua Copán* (PAPAC) (Maca and Wolf 2001), (3) *Die Architektur Der Sepulturas-Region Von Copán* (Hohmann 1995), and (4) *Die Arckitektur Von Copán* (Hohmann and Vogrin 1982).

The *sian otot* boundaries were delineated using descriptions from Leventhal (1979) and Fash (1983a).

Appendix B: GIS Data Collection and Conversion

Appendix B provides additional information on the GIS data collection and conversion that is not presented in Chapter 5−Methods.

Spatial data are collected in many different ways such as from Global Positioning Systems (GPS), paper maps, digital data, aerial photos and satellite images. Data collected and integrated into a Geographic Information System (GIS) using paper maps is often a relatively time-consuming yet cost-effective method to acquire data and integrate data into a GIS because mapped data—originally collected using a theodolite or total station—require a large amount of time, expensive equipment, and funding for fieldwork. Converting paper maps into a digital format is typically done using a scanner. These scanned images are often stored as TIFF (.tif) files, JPEG (.jpeg) files, or other common image formats.

In this project, 24 PAC I maps—each covering 1 sq km (scale 1:2000) and several architectural drawings (scale 1:200) from Hohmann (1995) and Hohmann and Vogrin (1982) were scanned on a large-bed scanner. The maps were scanned as JPEGS at a resolution of 600 dpi. These scanned data were in a raster (array of pixels) format and thus needed to be converted to a vector format (points, lines, or polygons) to be integrated into the Copán GIS. This process is referred to as v*ectorization*—the conversion of raster data to vector data. There are several options to vectorize data. These include 'heads-up digitizing' or using raster to vector conversion software packages such as WinTopo Professional or the ArcScan extension in ESRI's ArcGIS. I used the 'heads-up' digitizing method because it typically results in higher accuracy data than automatic conversion methods, especially when the maps are comprised of multiple layers (e.g. hydrology, roads, labels, and structures) as was the case in this project. The digitization was done in ArcGIS.

The spatial data sources for the Copán GIS are:

1. *Proyecto Arqueológico Copán* (PAC I) maps (Fash and Long 1983)
2. *Die Architektur Der Sepulturas-Region Von Copán* (Hohmann 1995)
3. *Die Arckitektur Von Copán* (Hohmann and Vogrin 1982)
4. *Proyecto Arqueológico para la Planificacion de la Antigua Copán* (PAPAC) (Maca and Wolf 2001)

Heads-Up Digitizing

A common way to create new features is to trace their shapes on screen using another layer for reference. This technique is called **heads-up digitizing**, or sometimes on-screen digitizing. When a feature is digitized, each click on the screen records and stores an x, y coordinate pair as part of the feature.

The layer used for reference during heads-up digitizing is called the base layer. Scanned paper maps, digital aerial photos, and other GIS layers are typically used as base layers. In this case, the scanned maps served as the base layers.

These scanned maps lacked spatial reference information, which means that they needed to be georeferenced to align them to other datasets. Data acquired from paper maps are often scanned to store in a digital format (**raster** data) such as a JPEG file; however, these data do not contain locational data, i.e., information as to where the objects (e.g. trails, streams, archaeological sites) represented on the map fit on the surface of the earth. Therefore, these digital data are often inadequate to perform analysis or display in proper alignment with other data. Thus, in order to use these types of raster data in conjunction with other spatial data, they need to be aligned, or georeferenced, to a map coordinate system.

Georeferencing

Georeferencing is the process of aligning raster data to map coordinates. During the process, a coordinate system is assigned that associates the data with a specific location on the earth. The coordinate system assigned is dependent upon the coordinate system assigned to the other spatial data being used in the analysis. Georeferencing raster data allows data to be viewed, queried, and analyzed with other geographic data.

For this project, I georeferenced the data to the Universal Transverse Mercator (UTM) projection. I chose the UTM coordinate system because the reference scale for the digitized files is automatically in meters, which allows for precise distance measurements of buildings, watercourses, and other digitized features. However, because the available maps provided only a single *x*, *y* coordinate (N14° 50', W89° 08') for the entire valley, I needed to collect GPS data from the site. I collected GPS points in the summer of 2006. The GPS data were collected using WGS 1984 datum and projected to Universal Transverse Mercator (UTM) Zone 16N.

The GPS points were downloaded using ***DNR Garmin***, a free software program created by the Minnesota Department of Natural Resources. Using the GPS data and the PAC I site grid, I created a UTM site grid to georeference the maps. I used the northwest corner of Structure 10L-4 for the datum (Figure B.1).

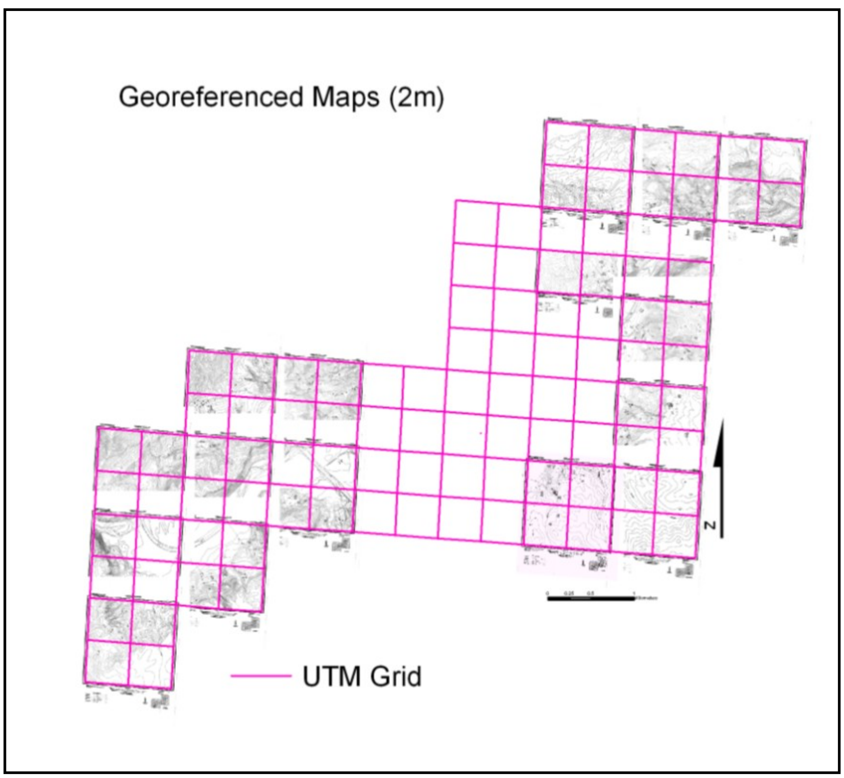


Figure B.1: UTM grid created to georeferenced scanned data for Copán, Honduras

Next, I created three "empty" shapefiles in ArcCatalog and added several attributes (or fields) to the attribute tables of the shapefiles. The following attributes were added: Group ID (Site #), Structure ID, Height (of buildings, stairs, stelae, and altars) Elevation (natural topography), Site Type, CPN Numbers, and Labels (e.g. *quebrada* names). These newly created shapefiles were added to an ArcMap document along with the georeferenced scanned maps (JPEGS). The next step was to digitize the data (structures, hydrology, *sacbeob*, and contour lines) from the scanned maps.

Digitizing

I digitized data for three shapefiles: *structures*, *hydrology*, and *contour lines*.

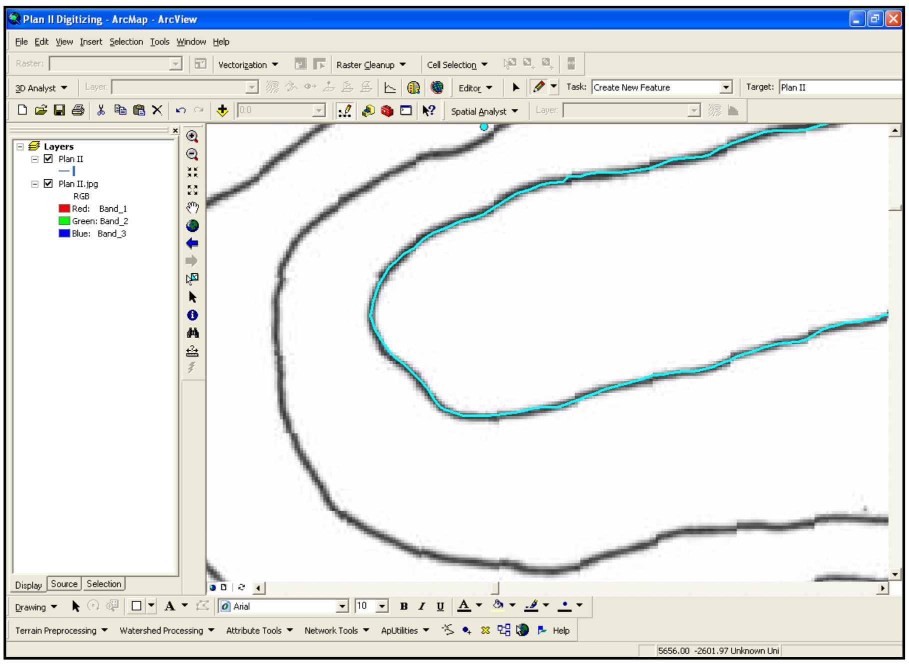


Figure B.2: Digitizing contour lines using scanned map as base layer

Digitized Layers

The Hohmann-Vogrin (1982) plans of the Principal Group comprise three layers: 1) contour lines, 2) structures, and 3) a site grid. I digitized only the *structures* layer as the other two layers were unnecessary for this project. The Hohmann (1995) plans of Las Sepulturas comprise only a structures layer, which I digitized. The PAC I maps comprises five layers: 1) contour lines, 2) structures, 3) hydrology, 4) roads, and 5) labels. I digitized each of these layers as separate shapefiles.

Digitizing Issues

The Hohmann-Vogrin Plan II map of the Principal Group was slightly misaligned in the southern area of the Principal Group at the location where the Acropolis begins (this problem is found on the original analog version and was not due to the scanning process) (Figure B.3). I, therefore, chose to digitize all features in the Acropolis adhering to the lines on Plan II (rather than attempting to match lines and digitize accordingly) and then selected all lines in the Acropolis and used the *Move* command in ArcGIS. In this way, I was able to preserve the spatial integrity of the data. I then used the *Merge* command to combine multiple features into single features. I did not have any other unusual problems digitizing the data.

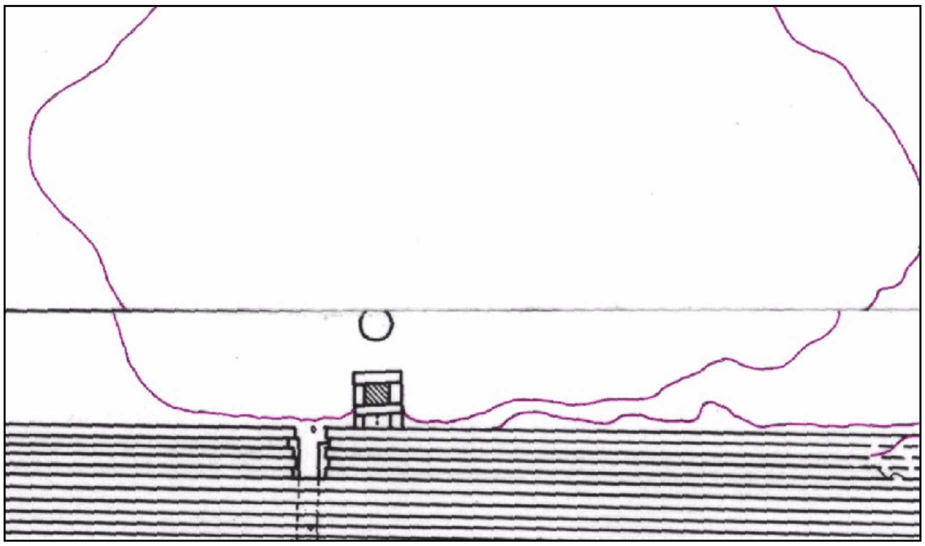


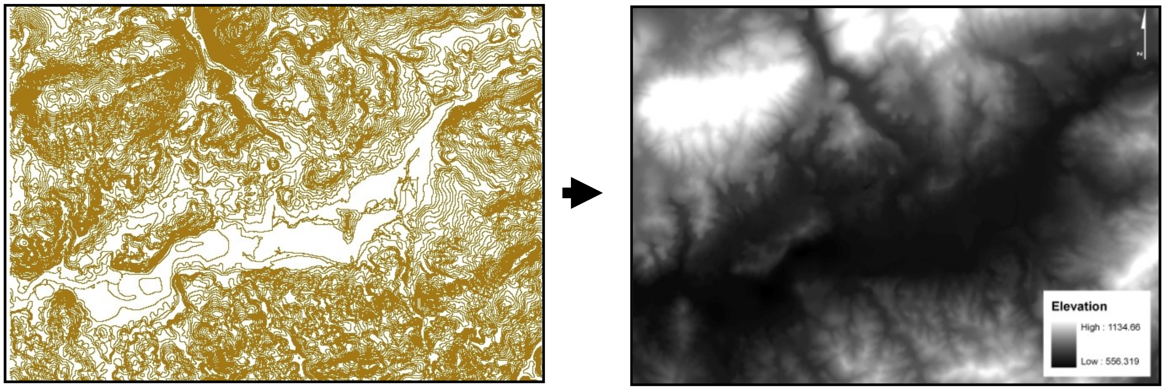
Figure B.3: Misalignment of Hohmann-Vogrin Plan II (1982)

Interpolation—Converting Digitized Contour Lines to a Digital Terrain Model (DTM)

Closing Open Lines

At this stage, the scanned contours had been converted into vector line features and merged. The next stage was to convert the contour lines into polygon features, which were necessary to convert the vector data into a continuous raster surface, that is, to convert the contour lines into a Digital Terrain Model (DTM). To create a raster surface all areas of the plan must be assigned data values, i.e. each pixel must have a value. Using the tools available within a GIS, it is required to have closed features (connected lines) to generate polygons from line features. Most of the contour lines were closed features; however, a few contour lines along the edges of the maps were not closed. In order to close the open polygons, I incorporated the boundary of the site grid into the contour file. I then split the boundary at each of the nodes connecting the contour lines to the grid boundary and merged the boundary to the appropriate contour line in order to assign elevation values to the boundary line. The elevation values corresponded to the appropriate contour lines. After all contour lines were closed, I used spatial interpolation to create the DTM from the *contour lines* shapefile.

Spatial interpolation is the process of calculating unknown values from a set of sample points with known values that are distributed across an area. I used the *Topo to Raster* tool in ArcGIS to convert the vector data into a surface by interpolating elevation values from the contour lines (Figure B.4). The resolution is technically at 0.5 meters; however, given that the surface was interpolated, the new raster surface gives a resolution of 0.156488 (output cell size) or approximately 15 cm.



Contours — Digital Terrain Model (DTM)

Figure B.4: Spatial interpolation process to convert contours to Digital Terrain Model

Converting Structures from Polylines to Polygons

The Hohmann and Hohmann-Vogrin plans have a larger scale than the PAC I maps (1:200 vs. 1:2000, respectively) and they were created using photogrammetric methods and thus, are more accurate and detailed than the PAC I maps. For these two reasons, I used the Hohmann-Vogrin plans for the Principal Group rather than the PAC I maps. The oval in Figure B.5 highlights an area in the East Court in which the Hohmann-Vogrin plans provide details that are absent from the PAC I maps.

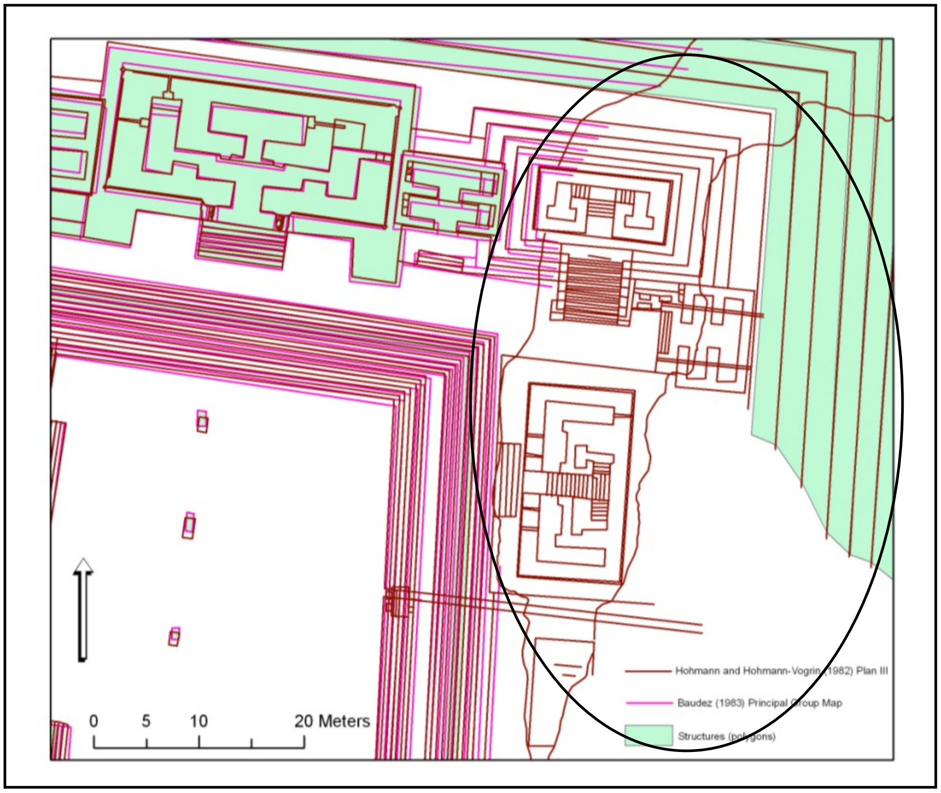


Figure B.5: Differences between Hohmann and Hohmann-Vogrin plans and PAC I maps

After deleting areas of overlap, I used the *append* tool to add the Hohmann and Hohmann-Vogrin features to the *structures* shapefile (created using the PAC I maps), combining the two layers into single shapefile. This same process was carried out for Las Sepulturas (Figure B.6). For this area of the site I georeferenced the Hohmann (1995) architectural plans and overlaid them onto the PAC I Las Sepulturas map. I modified the shapefile to incorporate the more accurate details from Hohmann's architectural plans. This typically resulted in the addition of previously unidentified stairways or low-lying mounds.

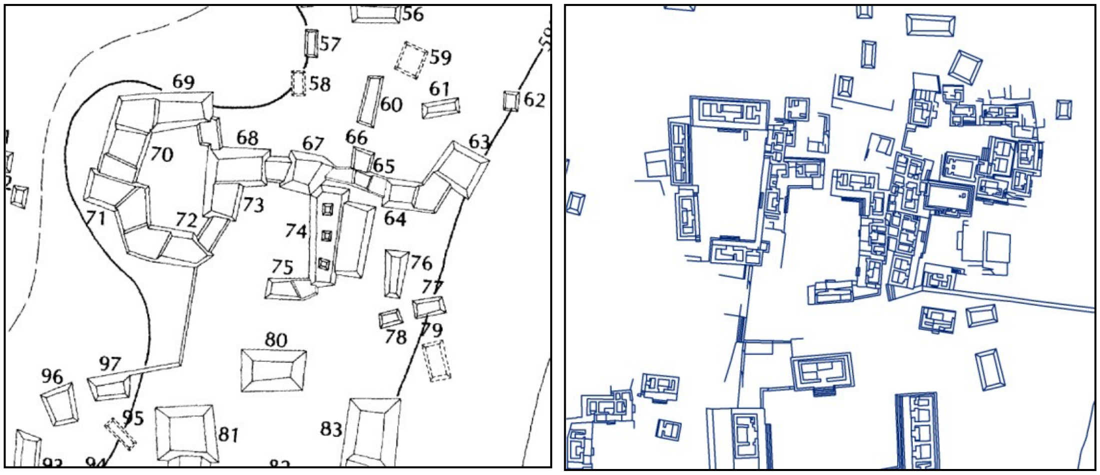


Figure B.6: Maps show differences between PAC I maps (left) and Hohmann (1995) plans (right)

The *structures* (polyline) shapefile was converted to polygons using a similar process to the one used to convert the contour lines. After all of the structures from the maps were digitized, i.e., converted to vectors, they were converted from polyline features to polygon features (Figure B.7).

Figure B.7: Polylines (left) converted to polygons (right)

Structures—Attributing and Editing

This phase involved attributing the structures with a z-value corresponding to height. Known heights were obtained from sources including books, dissertations, articles, and *informes* (field reports) and unknown heights were calculated using a basic trigonometric function (see Chapter 5 for details).

Attributing and Editing Structures and Stairways in Principal Group

The process involved selecting each line feature and attributing structure and step heights (Figure B.8). The data were obtained from the Hohmann-Vogrin (1982) plans of the Principal Group.

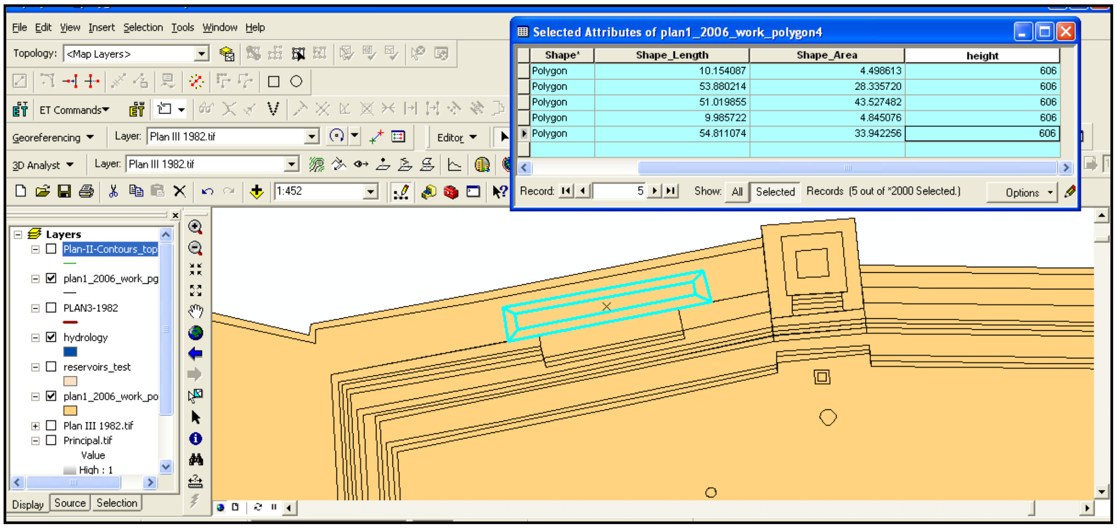


Figure B.8: Attributing the heights of Principal Group structures in ArcGIS

Attributing Structures in Las Sepulturas—Excavated and Unexcavated Structures

<u>Excavated Structures</u>

Table B.1 lists the (superstructure) heights of excavated structures at Las Sepulturas, Copán. The data are from Hohmann (1995).

Structure/Group	Height
Str. 9M-193	4.0 m
Str. 9M-194	4.8 m
Str. 9M-195	4.7 m
Str. 9M-196	4.2 m
Str. 9M-197	6.2 m
Str. 9M-199	4.15 m
Str. 9M-189	4.25 m
Str. 9M-191N	4.3 m
Str. 9M-191C	4.65 m
Str. 9M-191W	4.05 m
Str. 9M-190	3.9 m
Str. 9M-240	3.8 m
Str. 9M-245A	4.0 m
Str. 9M-245B	4.35 m
Str. 9M-246	3.9 m
Str. 9M-211	4.0 m
Str. 9M-213	4.3 m
Str. 9M-212	3.85 m
Str. 9N-80	6.75 m
Str. 9N-83	4.7 m

Str. 9N-82C	6.6 m
Str. 9N-83W	5.7 m
Str. 9N-82E	5.9 m
Str. 9N-82W	5.5 m
Str. 9N-81	5.3 m
Str. 9N-73	4.2 m
Str. 9N-73A	3.3 m
Str. 9N-68	4.4 m
Str. 9N-67	4.8 m
Str. 9N-74A	4.3 m
Str. 9N-7B	3.74 m
Str. 9N-74C	4.9 m
Str. 9N-75	3.8 m
Str. 9N-72	5.0 m
Str. 9N-72A	2.5 m
Str. 9N-71	5.0 m
Str. 9N-70	3.95 m
Str. 9N-69	5.15 m
Str. 9N-99	4.40 m
Str. 9N-100	5.1 m
Str. 9N-110A	4.2 m
Str. 9N-110B	6.85 m
Str. 9N-110C	4.8 m
Str. 9N-65	5.9 m
Str. 9N-60A	4.7 m
Str. 9N-60B	4.3 m
Str. 9N-60C	4.7 m
Str. 9N-61A	6.4 m
Str. 9N-61B	3.9 m
Str. 9N-63	4.5 m
Str. 9N-63A	3.5 m
Str. 9N-105	5.0 m
Str. 9N-92	4.7 m
Str. 9N-108	3.5 m
Str. 9N-93S	4.35 m
Str. 9N-93NA	4.4 m
Str. 9N-93NB	4.25 m
Str. 9N-96A	4.35 m
Str. 9N-96C	4.2 m
Str. 9N-96E	2.75 m
Str. 9N-97	4.6 m
Str. 9N-95	4.4 m
Str. 9N-91	4.5 m
Str. 9N-76	4.1 m
Str. 9N-64	4.9 m
Str. 9N-115	6.9 m
Str. 9N-112	3.9 m
Str. 9N-106	6.8 m
Str. 9N-107	3.9 m

Table B.1: (Superstructure) heights of excavated structures in Las Sepulturas, Copán

Unexcavated Structures

Exact heights were unavailable for the unexcavated structures and therefore a basic trigonometric function was used to calculate their heights.

Method—Calculating Height Using Harvard Typology

The Harvard Site Typology is based on architectural variables. One of these variables is construction materials/techniques. Different site types used different construction materials and techniques. The construction materials and techniques affected four variables that influence structure height. They are: 1) wall thickness, 2) wall height, 3) roof pitch (angle), and 4) platform height. Values for these four variables were determined for each site type 1–4. (See Chapter 5 for full explanation of methodology.)

Determining Platform Heights

Several sources were used to calculate average platform heights for each site type. Table B.2 lists the structure, platform height, site type, and the source for the platform height.

Structure	Platform Height	Site Type	Investigator(s)
10L-31	0.51	4	Hurst (1997)
10L-31b	0.43	4	Hurst (1997)
10L-42	0.65	4	Hurst (1997)
10L-41	1.4	4	Hurst (1997)
10L-34	0.58	4	Hurst (1997)
10L-33	0.57	4	Hurst (1997)
10L-44A	0.92	4	Hurst (1997)
10L-44-B	0.92	4	Hurst (1997)
9N-96	0.80	4	Hurst (1997)
9N-99	0.60	4	PAC II-Sanders (1990)
10L-43	1.30	4	Hurst (1997)
9N-82C	2.6	4	Hohmann (1995)
9N-82W	2.6	4	Hohmann (1995)
9N-82E	2.6	4	Hohmann (1995)
9N-81A	1.48	4	Hurst (1997)
9N-67	1.22	4	Hurst (1997); Sanders (1990)
9N-68	1.20 (patio level)	4	PAC II-Sanders (1990)
9N-69	1.24	4	PAC II-Sanders (1990)
9N-71	1.06	4	PAC II-Sanders (1990)
9N-72	1.36	4	PAC II-Sanders (1990)
9N-80	2.40	4	PAC II-Sanders (1986)
9N-61	0.90	4	PAC II-Sanders (1986)
9N-115	0.95	4	Hohmann (1995)
9N-108	0.30	4	PAC II--Sanders (1986)
9N-91	1.00	4	Hohmann (1995)
9N-88	0.38	4	PAC II-Sanders (1986)
10E-38	1.20	4	Baudez et al. (1983)
10E-46	1.30	4	Baudez et al. (1983)
10L-188	0.85	4	Baudez et al. (1983)
9N-80	2.20	4	Hohmann (1995)

9N-83	1.90	4	Hohmann (1995)
9N-73	2.30	4	Hohmann (1995)
9N-73A	2.30	4	Hohmann (1995)
9N-68	2.25	4	Hohmann (1995)
9N-67	1.30	4	Hohmann (1995)
9N-74A	1.25	4	Hohmann (1995)
9N-74B	1.25	4	Hohmann (1995)
9N-74C	1.15	4	Hohmann (1995)
9N-75	1.00	4	Hohmann (1995)
9N-72	1.70	4	Hohmann (1995)
9N-71	1.20	4	Hohmann (1995)
9N-70	1.00	4	Hohmann (1995)
9N-100	0.80	4	Hohmann (1995)
9N-110A	1.50	4	Hohmann (1995)
9N-100B	1.50	4	Hohmann (1995)
9N-110C	1.50	4	Hohmann (1995)
9N-65	1.15	4	Hohmann (1995)
9N-60A	0.40	4	Hohmann (1995)
9N-60B	0.40	4	Hohmann (1995)
9N-60C	0.40	4	Hohmann (1995)
9N-111	1.10 (east half)	4	Hohmann (1995)
9N-61A	1.10	4	Hohmann (1995)
9N-61B	1.00	4	Hohmann (1995)
9N-63	1.90	4	Hohmann (1995)
9N-63A	1.90	4	Hohmann (1995)
9N-105	0.60	4	Hohmann (1995)
9N-92	1.30	4	Hohmann (1995)
9N-108	0.30	4	Hohmann (1995)
9N-93S	0.60	4	Hohmann (1995)
9N-93NA	0.80	4	Hohmann (1995)
9N-93NB	0.40	4	Hohmann (1995)
9N-96C	0.40	4	Hohmann (1995)
9N-96E	0.90	4	Hohmann (1995)
9N-97	1.00	4	Hohmann (1995)
9N-95	0.20	4	Hohmann (1995)
9N-76	1.30	4	Hohmann (1995)
9N-64	4.30	4	Hohmann (1995)
9N-112	0.30	4	Hohmann (1995)
9N-106	0.90	4	Hohmann (1995)
9N-107	0.50	4	Hohmann (1995)
11L-124	0.50	3	Baudez (1983)
9M-193	0.90	3	Hohmann (1995)
9M-194	1.00	3	Hohmann (1995)
9M-195	2.05	3	Hohmann (1995)
9M-196	1.15	3	Hohmann (1995)
9M-197	1.8	3	Hohmann (1995)
9M-199	1.6	3	Hohmann (1995)
9M-189	2.05	3	Hohmann (1995)
9M-191N	0.90	3	Hohmann (1995)
9M-191C	1.00	3	Hohmann (1995)
9M-191W	1.00	3	Hohmann (1995)
9M-192	2.05	3	Hohmann (1995)

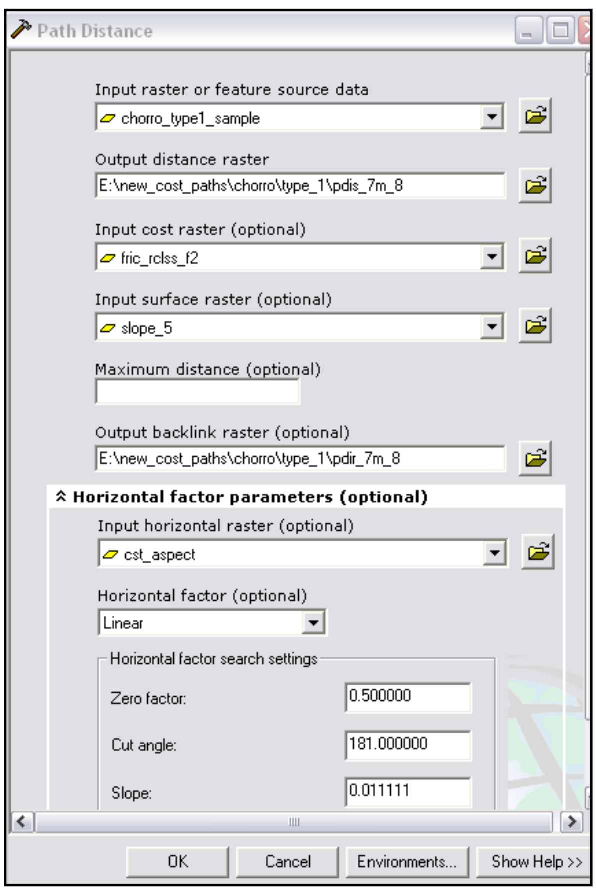
9M-190	0.90	3	Hohmann (1995)
9M-240	0.90	3	Hohmann (1995)
9M-245A	0.60	3	Hohmann (1995)
9M-245B	0.60	3	Hohmann (1995)
9M-246	0.75	3	Hohmann (1995)
10L-85	0.54	2	Hurst (1997)
9M-211	0.65	1	Hohmann (1995)
9M-213	0.90	1	Hohmann (1995)
9M-212	0.60	1	Hohmann (1995)

Table B.2: Platform heights for residential structures at Copán

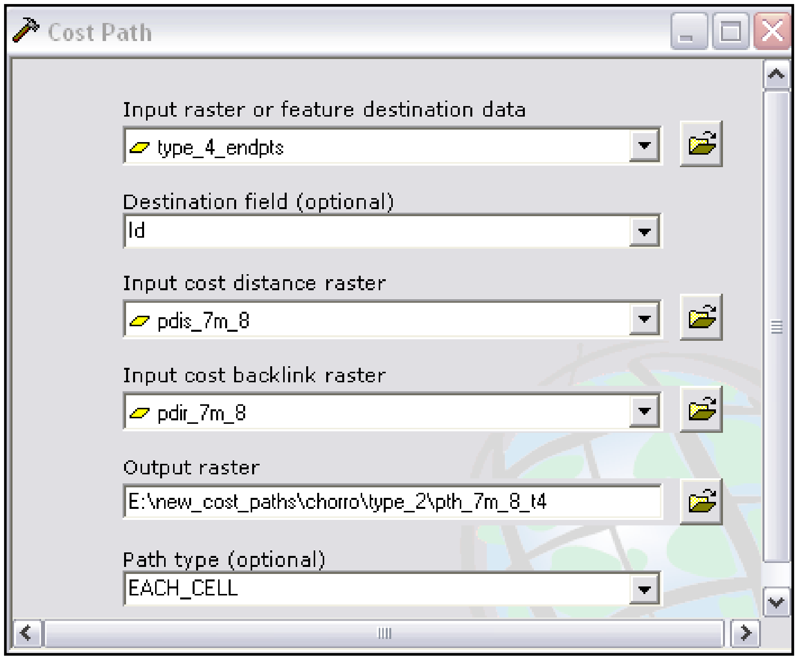
The next section describes the process and tools in ArcGIS used to calculate access (integration) and visibility.

Methodology for Calculating Access (Integration)

1. Go to **Spatial Analyst Tools**
2. Click on **Distance** Toolset
3. Click on **Path Distance** Tool
4. Create Cost Distance and Cost Direction (backlink raster) Surfaces



5. Click on the **Cost Path** Tool to create least-cost paths from source to type sites. This needs to be done four times to generate paths to site types 1-4.



6. Export pathcosts to *Excel* spreadsheet. Right click on the newly created paths (raster datasets), open the attribute table, click on Options, and then click Export to create an Excel spreadsheet. Repeat this process for each of the destinations (i.e. site types 1-4).

7. Import into *Minitab* (statistical software package) to carry out statistical tests.

Creating Viewsheds

IDIRISI was used to create the viewsheds because ArcGIS 9.1 was limited to points or lines. Given that the analysis requires that all structures within a site(rather than a single point or line feature) be used to create the viewshed, a polygon file is required. IDRISI allows polygons to be used in viewshed analyses.

The initial steps occur in ArcGIS. First, select appropriate Group from *structures* (polygon) shapefile and export the data as a new shapefile. Second, import the shapefile into IDRISI as a vector (.vct) file and set the reference system as UTM 16N, reference units as meters, and unit distance as 1.0 meters. Third, reformat the vector file into a raster (.rst) file and copy image parameters from the Urban-View DEM. Set the output data type as integer and initial value as 0.

In IDRISI use the context operator 'VIEWSHED' to generate viewsheds for the same sites that were used in the access/integration analysis. (The time to create each viewshed ranges from 30 minutes to 12 hours depending on the size of the raster file used to create it.) The IDRISI viewshed was exported as a GEOTIFF and then imported into ArcGIS 9.1 as a raster grid.

Using Viewsheds to Calculate Visibility Values

General Topographic Prominence

Topographic prominence refers to a site's overall visibility in the Copán Valley. A percentage was calculated by dividing the number of visible pixels from each viewshed by the overall number of pixels for the valley.

Calculating Visual Connectedness for Site Types 1−4

To calculate the visual connectedness (intervisibility) between the sample sites and Copán's four residential site types required four additional steps (beyond those required to calculate topographic prominence). First, the viewsheds for each site type were 'extracted' for each site, i.e., all type 1 sites were extracted from each sample site's viewshed. The process was repeated for type 2, type 3, and type 4 sites. The process was repeated four times for each viewshed. I used the EXTRACT BY MASK tool from the Spatial Analyst Tools in ArcGIS (Figure B.9).

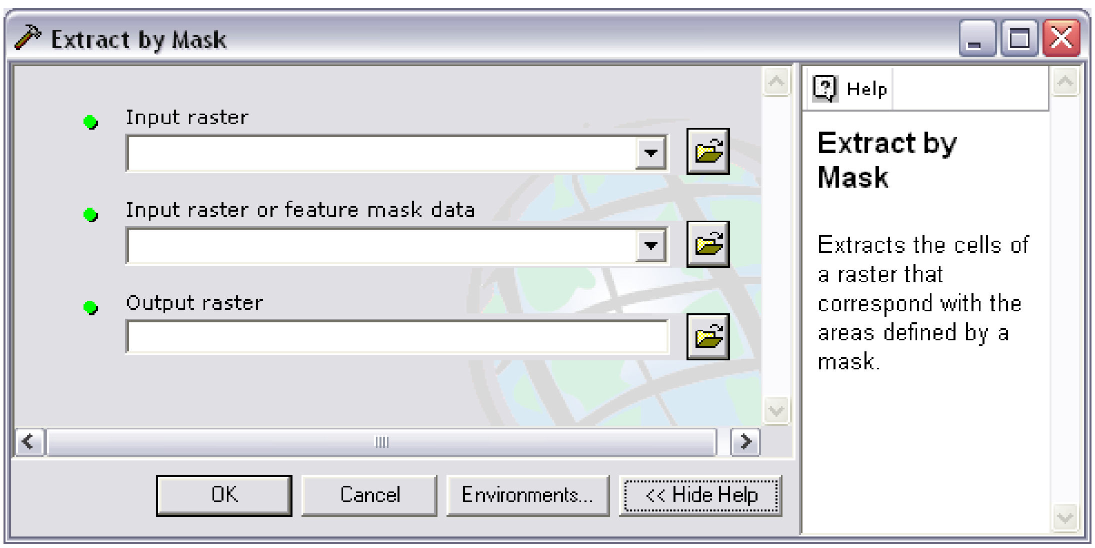


Figure B.9: Using Extract by Mask tool in ArcGIS to calculate visual connectedness

Second, the extracted viewsheds (there are four for each sample site) were converted from a raster format into a vector format; that is, four new shapefiles were created (Figure B.10). This conversion was necessary in order to union ("join") the attributes from the four new shapefiles, which did not have any attribute information beyond non-visible or visible, to the sample site in order to link Group labels (e.g. 11N−4) to the extracted viewshed.

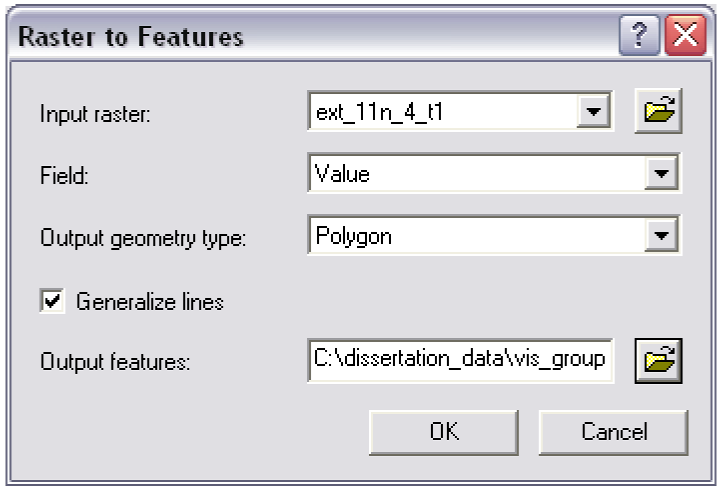


Figure B.10: Converting extracted viewsheds from a raster to a vector (shapefile) format

Third, I used the UNION tool in ArcGIS to intersect the new shapefiles with each of the four site types into a single shapefile the required attributes. Figure B.11 shows an example of how the Union tool was used to combine a sample site (e.g. 11N−4) with all type 1 sites in the valley. The result is a shapefile whose attribute table contains information about group labels and visibility (along with other attribute data) (Figure B.12).

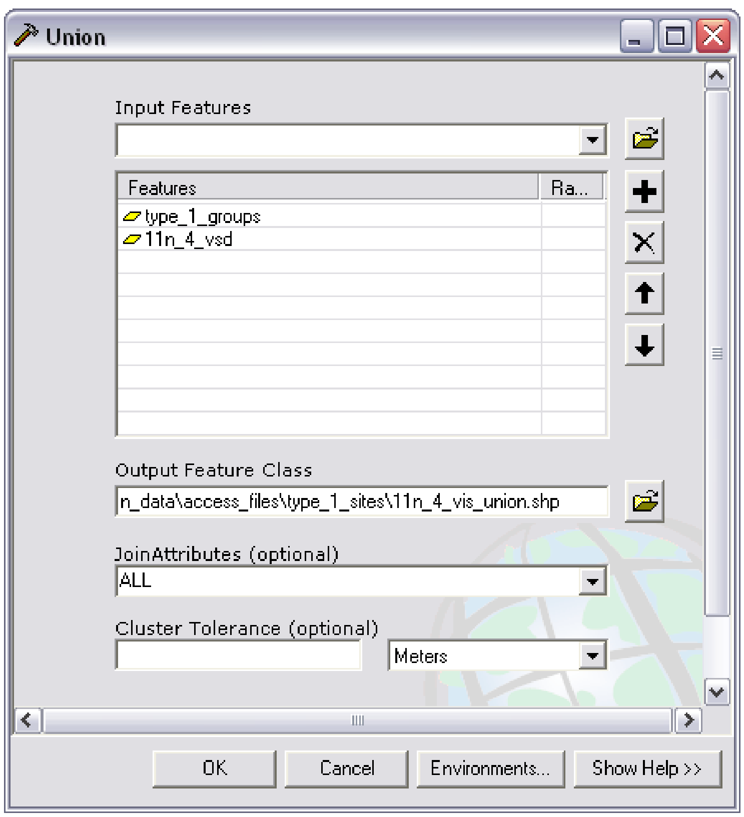
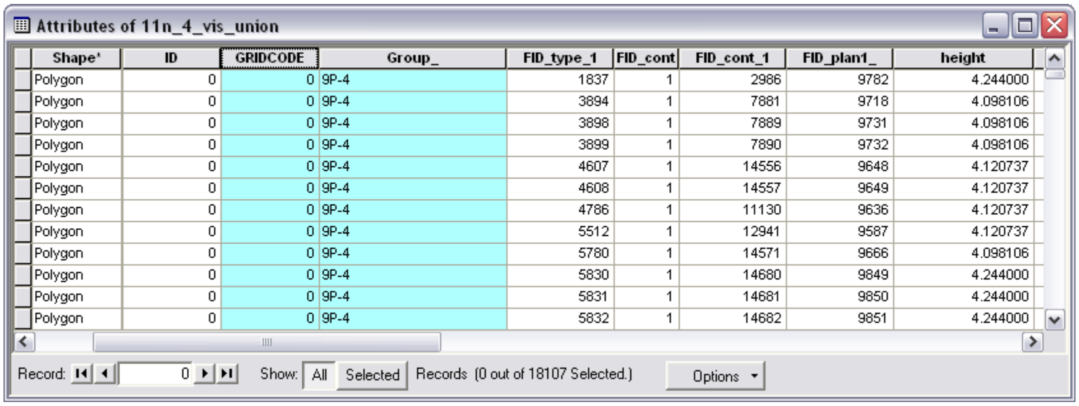


Figure B.11: Example of Union to intersect extracted viewsheds and subset of site types



Attributes of 11n_4_vis_union

Shape*	ID	GRIDCODE	Group_	FID_type_1	FID_cont	FID_cont_1	FID_plan1_	height
Polygon	0	0	9P-4	1837	1	2986	9782	4.244000
Polygon	0	0	9P-4	3894	1	7881	9718	4.098106
Polygon	0	0	9P-4	3898	1	7889	9731	4.098106
Polygon	0	0	9P-4	3899	1	7890	9732	4.098106
Polygon	0	0	9P-4	4607	1	14556	9648	4.120737
Polygon	0	0	9P-4	4608	1	14557	9649	4.120737
Polygon	0	0	9P-4	4786	1	11130	9636	4.120737
Polygon	0	0	9P-4	5512	1	12941	9587	4.120737
Polygon	0	0	9P-4	5780	1	14571	9666	4.098106
Polygon	0	0	9P-4	5830	1	14680	9849	4.244000
Polygon	0	0	9P-4	5831	1	14681	9850	4.244000
Polygon	0	0	9P-4	5832	1	14682	9851	4.244000

Record: 0 Show: All Selected Records (0 out of 18107 Selected.) Options

Figure B.12: Attribute table of "unioned" shapefile for sample site 11N−4

Fourth, I summarized the Group field by GRIDCODE (0 = non-visible and 1 = visible) using the *Sum* option (Figure B.13).

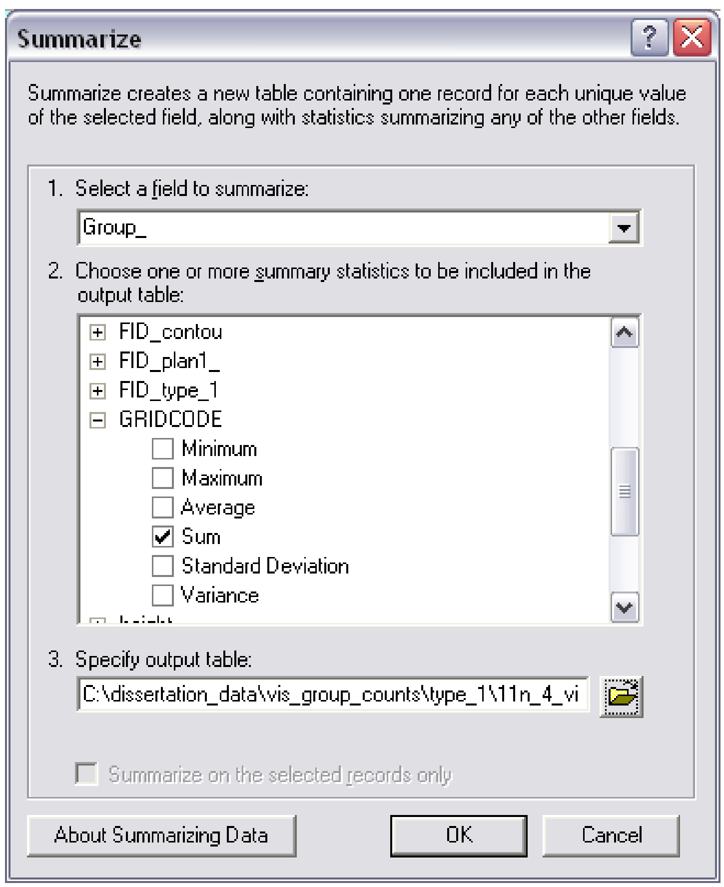


Figure B.13: Using Summarize tool in ArcGIS to calculate total number of visible type 1 sites from sample site 11N−4

The result was a data output table that summed the sites according to non-visible or visible. If Sum_GRIDCODE had a value = 0 then the site was non-visible. If it had a value > 1 then at least some portion of that site was visible from a particular site. Figure B.14 shows that Group 11N-4 is visible from 10J-9, 10J-7, etc (highlighted in cyan), but is not visible from 9P-2, 9O-2, etc. In this example, Group 11N−4 was visible from 291 (out of 443) type 1 sites.

Attributes of 11n_4_vis

OID	Group_	Count_Group_	Sum_GRIDCODE
388	9H-4	19	0
389	9H-5	31	0
390	9I-2	33	0
412	9L-18	20	0
414	9L-20	29	0
415	9L-21	56	0
438	9O-1	10	0
439	9O-2	10	0
440	9P-2	12	0
26	10J_9	2	1
24	10J-7	6	2
41	10M-4	6	2
44	10M-7	8	2
85	11I-2	6	2
120	11M-3	4	2
135	11P-1	4	2

Record: 0 Show: All Selected Records (293 out of 443 Selected.) Options

Figure B.14: Data output table summarizing total number of visible vs. non−visible type 1 sites for sample site 11N−4

Directionality

"Higuchi Viewsheds", which divide visual landscapes into three categories—near-distance (foreground); middle-distance (middle ground), and far-distance (background) depending on the standard object height—were generated using ArcGIS 9.1 for use in the directionality analysis.

The approach used to create these viewsheds was modified from Wheatley and Gillings (2000) and included eight steps: (1) calculate near−, mid−, and far-distance zones using Higuchi criteria; (2) calculate a binary viewshed for a location; (3) create multiple buffers using calculated Higuchi distance zones; (4) convert multiple buffers to Triangulated Irregular Network (TIN); (5) create aspect layer from TIN; (6) convert Aspect TIN to raster and reclassify; (7) use map algebra to multiply the binary viewshed by the aspect (raster) surface; (8) use near−, mid−, and far-distance zones to extract in-view areas, and; (9) produce a histogram or summary statistics for proportion of cells in the in-view areas for each directional zone.

Step 1—calculate near−, mid−, and far-distance zones

Higuchi (1983) divides visual landscapes into three categories: near-distance (foreground); middle-distance (middle ground), and far-distance (background). These distances vary depending on the standard object height. In this case, the average height of type 1−4 structures (4.7 meters) at Copán was used. The near-distance is equivalent to a horizontal angle of 1 degree, or approximately 60 times the size of the average structure, and structures in this view are perceived as being immediate and close to the viewer. The middle-distance is equivalent to a horizontal angle of 3 degrees, or equal to a distance of 1,100 times the size of the average structure, and the shapes structures are visible but lack details. The far-distance is defined beyond the middle-distance to infinity and individual structures are no longer identifiable but clusters of buildings are visible. Given that the average structure height for Copán (excluding ceremonial buildings of Principal Group) is 4.7 meters, the following distances were calculated. The near-distance visibility ranged from 0−282 meters, the middle-distance from 283−5170 meters, and the far-distance ranged from 5170 meters to the valley boundaries. These distances were used in the generation of the directionality maps.

Step 2- calculate a binary viewshed for a location
I created viewsheds with pixel values = 0 are non−visible and pixel values = 1 are visible for each sample site.

Step 3- create multiple buffers using calculated Higuchi distance zones
Two buffers were created—one for near-distance and the other for mid-distance. The same polygon shapefiles that were used to calculate viewsheds were also used. The Multiple Ring Buffer tool (proximity tool) in the Spatial Analysis Toolbox in ArcGIS was used to create a new shapefile with the near− and mid−distance buffers (Figure B.15).

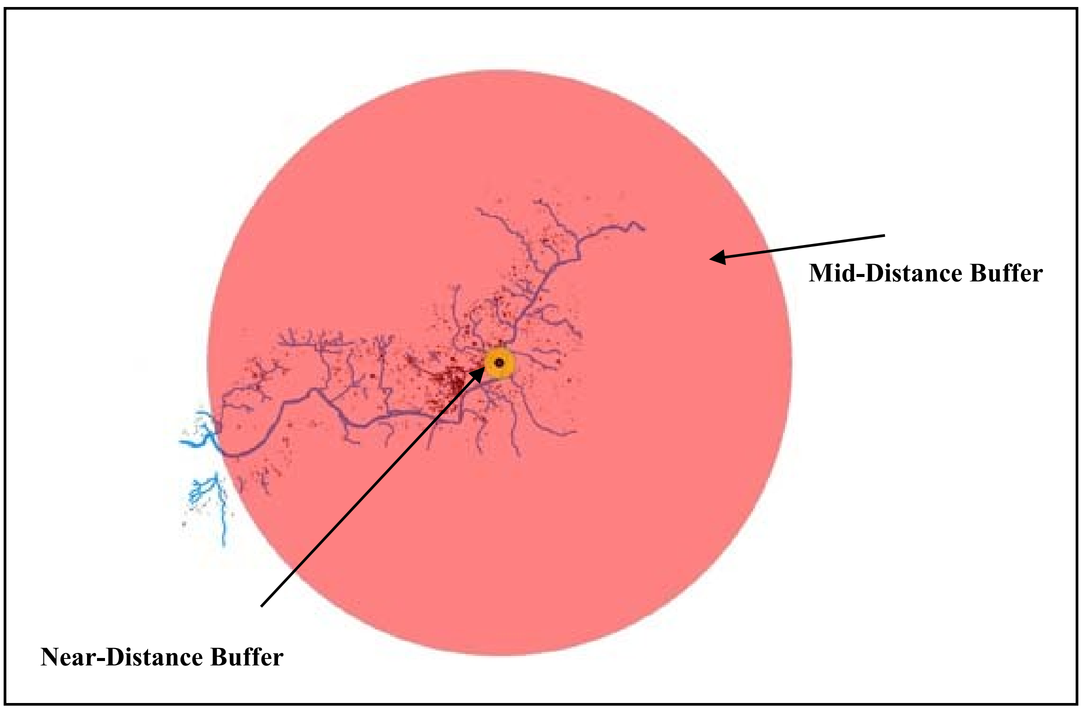


Figure B.15: Near− and mid−distance buffers used to create directionality maps

Step 4–convert multiple buffers to Triangulated Irregular Network (TIN)
I used the *Create TIN from features* tool on the 3D Analyst Toolbar to generate a Triangulated Irregular Network (TIN) (Figure B.16). A TIN is constructed by triangulating a set of vertices, which are connected with a series of edges to form a network of triangles and creates a

continuous surface. In this case, a Distance TIN was generated using the multiple buffer file. This step was necessary in order to convert the shapefile, which is a discrete (non-continuous) object, into a distance surface.

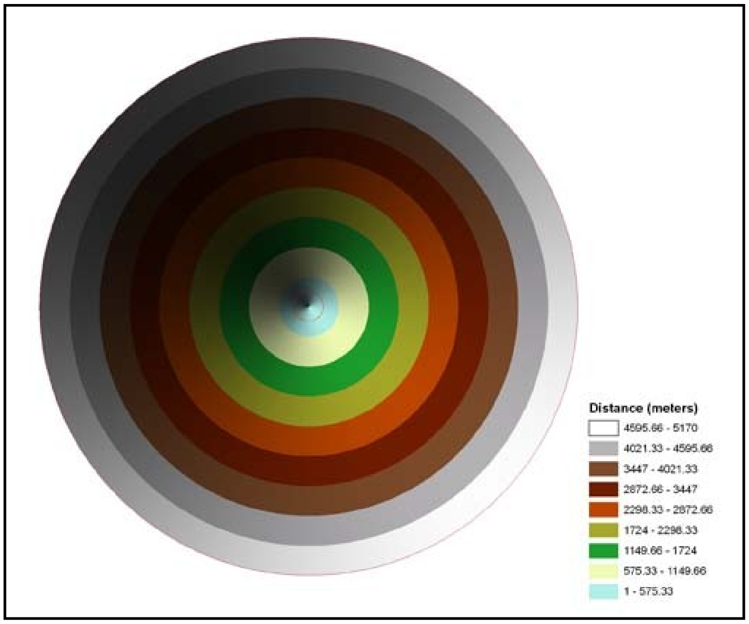


Figure B.16: Example of a Distance TIN created using buffers

Step 5–create aspect layer from TIN

I used the *TIN Aspect* tool from the 3D Analyst Tools in the TIN Surface Toolbox to create an Aspect TIN (direction of steepest downhill slope) from the Distance TIN generated in step 4. Each TIN triangle is classified into an aspect class (Figure B.17). There are eight, 45° classes: north, northeast, east, southeast, south, southwest, west, and northwest. Codes 1 through 8 are used, respectively, to represent these aspect classes. Contiguous triangles belonging to the same class were merged during the formation of output polygons.

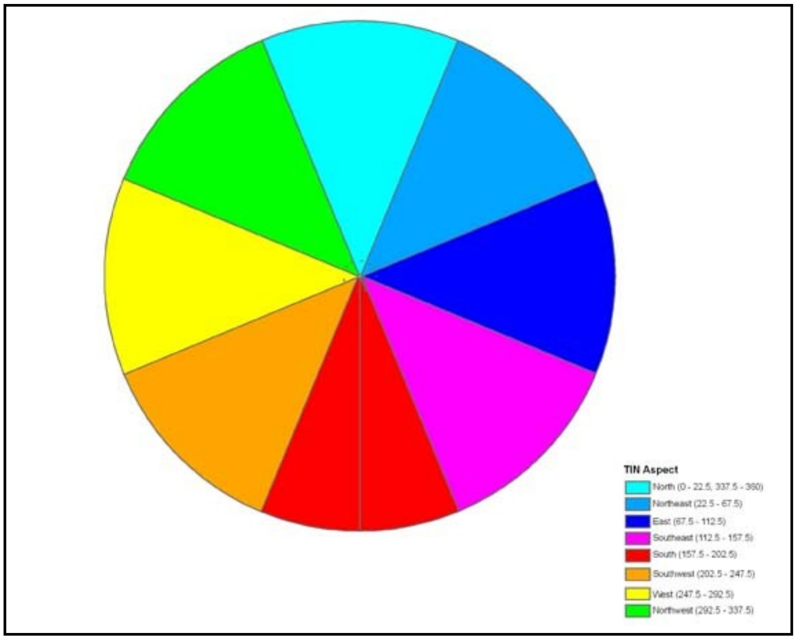


Figure B.17: Example of Aspect TIN created using Distance TIN

Step 6–convert Aspect TIN to raster format
I used the *Convert Features to Raster* tool on the Spatial Analyst Toolbar to convert the Aspect TIN to a raster format. This resulted in a continuous surface that was necessary for calculating directionality.

Step 7–use map algebra to multiply the binary viewshed by the aspect (raster format)
I used the *Times* tool in the Math Toolbox in the Spatial Analyst Tools to perform map algebra on the Aspect TIN (raster). I multiplied the Aspect TIN (raster) and binary viewshed to assign directionality to the original viewshed and create a directionality map (Figure B.18).

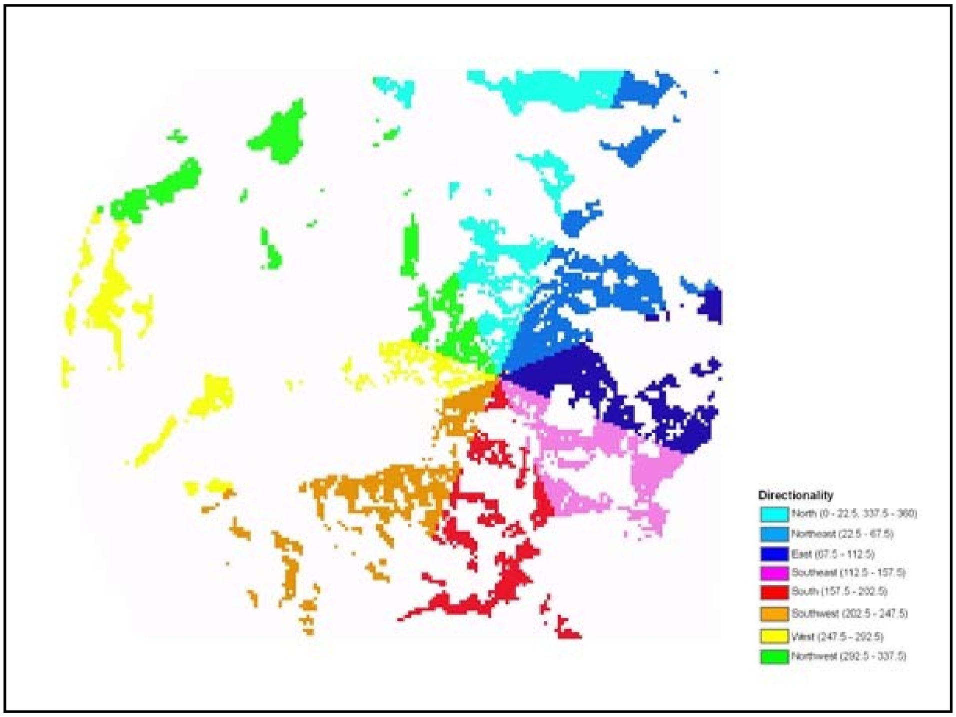


Figure B.18: Example of a directionality map created from Higuchi Viewshed

Step 8–Use near and mid-distance zones to extract in-view areas
Using near-buffer shapefiles apply the *Extract by Mask* tool in the Spatial Analyst Toolbox. This resulted in an attribute table with the number of visible pixels, or magnitude, for each direction (N, S, E, W, NE, SE, NW, SE) from the sample site within the near-distance zone. The magnitude for the mid-distance zone was calculated by subtracting the magnitude of the near-distance from the magnitude of the total distance for both near- and mid-distance zones.

Step 9–produce a histogram (summary statistics) of magnitude for eight directions
The number of visible pixels for each direction was automatically generated in an attribute table in ArcGIS 9.1. This table was exported in Microsoft Excel where a histogram illustrating magnitude and direction of visible pixels was created.

Calculating intra-(sub)community visibility

Use *Clip* tool in the Extract Menu of the Analysis Toolbox to extract input features (sites) that overlay the clip feature (*sian otot* boundary) (Figure B.19).

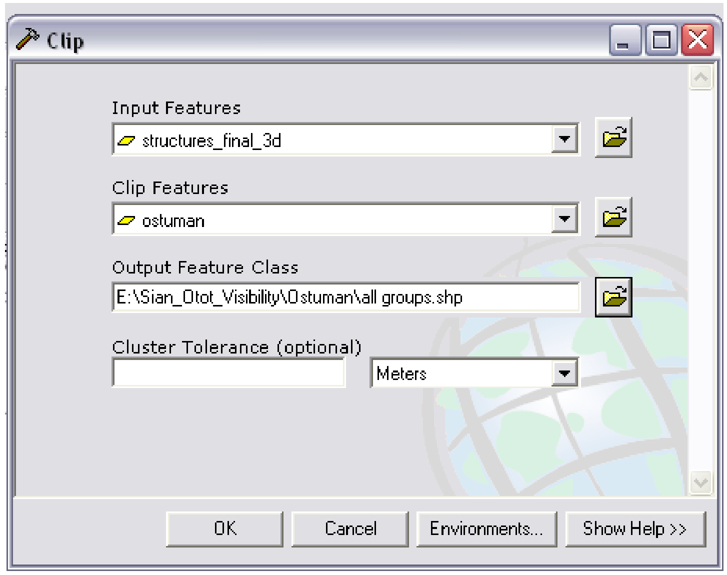


Figure B.19: Using clip tool to extract sites from each of Copán's sub−communities

Symbolize Sites according to site type and then use viewsheds for each relevant site type to determine counts for visible sites by site type.

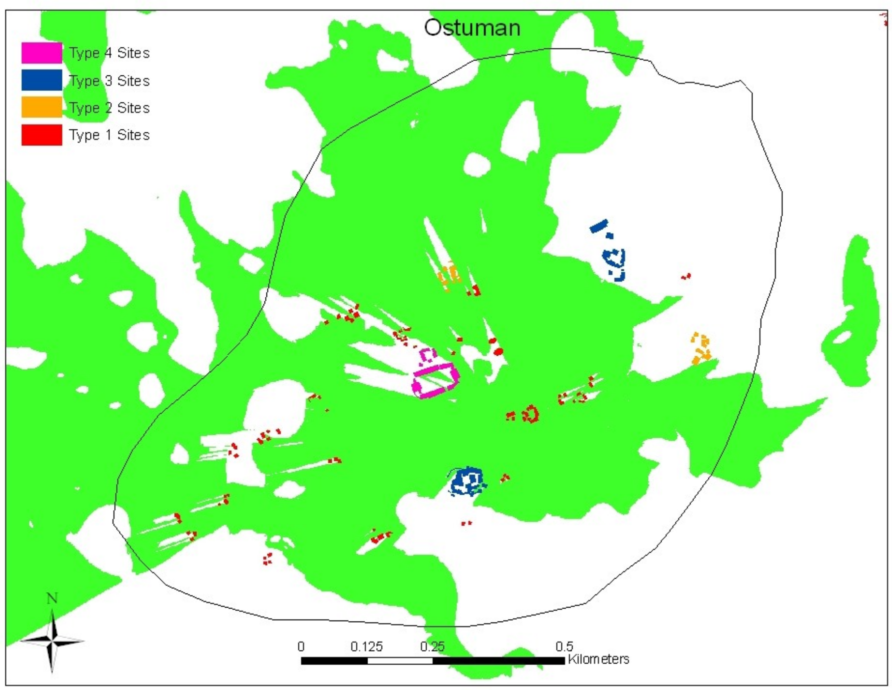


Figure B.20: Intra-community visibility for Group 10E-4 (type 1), Ostuman

Appendix C: List of Sample Sites in Access Analysis

	Site	Site Type	Zone	Urban/Hinterland	*Sian Otot*
1	Great Plaza	5	2	Urban	Principal Group
2	West Court	5	2	Urban	Principal Group
3	East Court	5	2	Urban	Principal Group
4	Royal Courtyard	5	2	Urban	Principal Group
5	Group 11L-17	1	2	Urban	El Bosque
6	Group 10J-1	1	2	Urban	El Bosque
7	Group 11L-3	2	2	Urban	El Bosque
8	Group 11L-13	3	2	Urban	El Bosque
9	Group 10J-6	3	2	Urban	El Bosque
10	Group 11K-6	4	2	Urban	El Bosque
11	Group 10L-18	4	2	Urban	El Bosque
12	Group 9M-15	1	2	Urban	Las Sepulturas
13	Group 9M-9	2	2	Urban	Las Sepulturas
14	Group 9M-16	3	2	Urban	Las Sepulturas
15	Group 9N-8	4	2	Urban	Las Sepulturas
16	Group 8L-1	1	3	Urban	Salamar
17	Group 8L-4	2	3	Urban	Salamar
18	Group 9L-8	2	3	Urban	Salamar
19	Group 9K-4	3	3	Urban	Salamar
20	Group 8L-10	3	3	Urban	Salamar
21	Group 8L-12	4	3	Urban	Salamar
22	Group 9K-16	1	3	Urban	Comedero
23	Group 9J-4	2	3	Urban	Comedero
24	Group 9J-5	4	3	Urban	Comedero
25	Group 7M-15	1	3	Urban	Chorro
26	Group 7M-8	2	3	Urban	Chorro
27	Group 7M-16	3	3	Urban	Chorro
28	Group 6N-6	1	3	Hinterland	Rastrojon
29	Group 7N-13	1	3	Hinterland	Rastrojon
30	Group 7N-4	2	3	Hinterland	Rastrojon
31	Group 6N-2	2	3	Hinterland	Rastrojon
32	Group 7M-4	3	3	Hinterland	Rastrojon
33	Group 5P-4	1	3	Hinterland	Mesa de Petapilla
34	Group 4O-14	1	3	Hinterland	Mesa de Petapilla
35	Group 5O-7	2	3	Hinterland	Mesa de Petapilla
36	Group 5O-1	3	3	Hinterland	Mesa de Petapilla
37	Group 4Q-7	1	3	Hinterland	Bolsa de Petapilla
38	Group 3O-3	1	3	Hinterland	Bolsa de Petapilla
39	Group 3O-8	2	3	Hinterland	Bolsa de Petapilla
40	Group 4Q-2	1	3	Hinterland	Titoror
41	Group 10H-4	1	3	Hinterland	El Pueblo
42	Group 10H-2	2	3	Hinterland	El Pueblo
43	Group 9I-1	4	3	Hinterland	El Pueblo
44	Group 8P-5	1	4	Hinterland	Titichon

45	Group 7O-4	1	4	Hinterland	Titichon
46	Group 8P-9	2	4	Hinterland	Titichon
47	Group 8O-2	2	4	Hinterland	Titichon
48	Group 9P-5	2	4	Hinterland	Titichon
49	Group 11P-5	1	4	Hinterland	San Rafael
50	Group 10O-4	1	4	Hinterland	San Rafael
51	Group 10P-4	2	4	Hinterland	San Rafael
52	Group 11N-4	1	4	Hinterland	San Lucas
53	Group 11M-1	1	4	Hinterland	San Lucas
54	Group 11M-10	2	4	Hinterland	San Lucas
55	Group 12K-1	1	4	Hinterland	El Puente
56	Group 12L-1	2	4	Hinterland	El Puente
57	Group 12G-5	1	5	Hinterland	Algodonal
58	Group 12F-3	3	5	Hinterland	Algodonal
59	Group 14E-4	1	5	Hinterland	Estanzuela
60	Group 13F-1	2	5	Hinterland	Estanzuela
61	Group 14F-1	3	5	Hinterland	Estanzuela
62	Group 15D-5	1	5	Hinterland	Tapescos
63	Group 15C-2	1	5	Hinterland	Tapescos
64	Group 12D-5	1	5	Hinterland	Rincon del Buey
65	Group 12D-6	2	5	Hinterland	Rincon del Buey
66	Group 11D-3	1	5	Hinterland	Ostuman
67	Group 10E-4	1	5	Hinterland	Ostuman
68	Group 10F-3	2	5	Hinterland	Ostuman
69	Group 10F-1	3	5	Hinterland	Ostuman
70	Group 10E-6	4	5	Hinterland	Ostuman
71	Group 9H-3	1	5	Hinterland	Yaragua
72	Group 9G-5	2	5	Hinterland	Yaragua
73	Group 3N-2	1	3	Hinterland	Quebrada Seca
74	Group 3M-1	2	3	Hinterland	Quebrada Seca

Appendix D: Access Data Tables

Due to the large number and size of data tables, the appendix includes seven sample data tables from the sub-community of El Bosque and not all of the original access tables. The tables list *start type, zone,* and *sian otot* for the source site and the *pathcosts* to travel to from the source site to the *end type* (destination site). The data from these tables was imported into Minitab 15 to test for statistical significance.

Source Site: Group 10L-17

Start Type	Pathcosts	Zone	*Sian Otot*	End Type
1	13801.03613280000	2	El Bosque	1
1	13807.59082030000	2	El Bosque	1
1	13635.85058590000	2	El Bosque	1
1	13513.98046880000	2	El Bosque	1
1	13145.84179690000	2	El Bosque	1
1	14725.75976560000	2	El Bosque	1
1	12711.51855470000	2	El Bosque	1
1	14494.39550780000	2	El Bosque	1
1	13038.00585940000	2	El Bosque	1
1	12901.96875000000	2	El Bosque	1
1	12877.74218750000	2	El Bosque	1
1	12513.27343750000	2	El Bosque	1
1	12474.15332030000	2	El Bosque	1
1	12471.71191410000	2	El Bosque	1
1	12353.69726560000	2	El Bosque	1
1	12217.96484380000	2	El Bosque	1
1	12185.17480470000	2	El Bosque	1
1	12925.33886720000	2	El Bosque	1
1	13084.46582030000	2	El Bosque	1
1	11942.89843750000	2	El Bosque	1
1	11767.19628910000	2	El Bosque	1
1	11447.04003910000	2	El Bosque	1
1	12872.50878910000	2	El Bosque	1
1	11309.25976560000	2	El Bosque	1
1	12007.78710940000	2	El Bosque	1
1	11437.45117190000	2	El Bosque	1
1	11652.76953130000	2	El Bosque	1
1	11192.16308590000	2	El Bosque	1
1	11202.47070310000	2	El Bosque	1
1	11221.04785160000	2	El Bosque	1
1	11067.40136720000	2	El Bosque	1
1	11109.04589840000	2	El Bosque	1
1	10851.28710940000	2	El Bosque	1
1	10594.78222660000	2	El Bosque	1
1	11539.08691410000	2	El Bosque	1
1	10878.40234380000	2	El Bosque	1

1	10545.77734380000	2	El Bosque	1
1	10808.10058590000	2	El Bosque	1
1	10737.27050780000	2	El Bosque	1
1	10620.15722660000	2	El Bosque	1
1	10651.69335940000	2	El Bosque	1
1	10782.43554690000	2	El Bosque	1
1	10682.33886720000	2	El Bosque	1
1	10557.46289060000	2	El Bosque	1
1	10475.06250000000	2	El Bosque	1
1	12308.43261720000	2	El Bosque	1
1	12517.68554690000	2	El Bosque	1
1	10931.10937500000	2	El Bosque	1
1	10605.70605470000	2	El Bosque	1
1	10293.68945310000	2	El Bosque	1
1	10507.03808590000	2	El Bosque	1
1	10474.51757810000	2	El Bosque	1
1	10160.73437500000	2	El Bosque	1
1	10526.40429690000	2	El Bosque	1
1	10459.02929690000	2	El Bosque	1
1	9910.79101563000	2	El Bosque	1
1	9758.29492188000	2	El Bosque	1
1	9570.06835938000	2	El Bosque	1
1	9596.24902344000	2	El Bosque	1
1	9395.95312500000	2	El Bosque	1
1	9246.23828125000	2	El Bosque	1
1	8943.52050781000	2	El Bosque	1
1	8779.24707031000	2	El Bosque	1
1	8668.47949219000	2	El Bosque	1
1	8554.66796875000	2	El Bosque	1
1	8625.06933594000	2	El Bosque	1
1	8457.38281250000	2	El Bosque	1
1	8480.55175781000	2	El Bosque	1
1	8299.60937500000	2	El Bosque	1
1	8969.37890625000	2	El Bosque	1
1	8584.43164063000	2	El Bosque	1
1	8507.51269531000	2	El Bosque	1
1	8007.37744141000	2	El Bosque	1
1	8112.35888672000	2	El Bosque	1
1	8158.07373047000	2	El Bosque	1
1	8052.61767578000	2	El Bosque	1
1	7845.69775391000	2	El Bosque	1
1	7343.15625000000	2	El Bosque	1
1	7722.66162109000	2	El Bosque	1
1	7590.29150391000	2	El Bosque	1
1	7622.66650391000	2	El Bosque	1
1	7697.12158203000	2	El Bosque	1
1	7070.40625000000	2	El Bosque	1
1	7468.61572266000	2	El Bosque	1
1	6984.62353516000	2	El Bosque	1

1	7439.24951172000	2	El Bosque	1
1	7026.18408203000	2	El Bosque	1
1	6928.93212891000	2	El Bosque	1
1	7187.16113281000	2	El Bosque	1
1	7002.13867188000	2	El Bosque	1
1	10140.89550780000	2	El Bosque	1
1	6548.86376953000	2	El Bosque	1
1	6660.29443359000	2	El Bosque	1
1	6449.08886719000	2	El Bosque	1
1	6611.31738281000	2	El Bosque	1
1	6947.48388672000	2	El Bosque	1
1	6449.34667969000	2	El Bosque	1
1	6692.58398438000	2	El Bosque	1
1	6335.36767578000	2	El Bosque	1
1	6296.43701172000	2	El Bosque	1
1	6637.66015625000	2	El Bosque	1
1	6070.56982422000	2	El Bosque	1
1	7479.94531250000	2	El Bosque	1
1	6297.25292969000	2	El Bosque	1
1	6402.18505859000	2	El Bosque	1
1	6999.03515625000	2	El Bosque	1
1	7263.44091797000	2	El Bosque	1
1	9387.89453125000	2	El Bosque	1
1	8235.72265625000	2	El Bosque	1
1	6204.69628906000	2	El Bosque	1
1	6148.45166016000	2	El Bosque	1
1	6209.79150391000	2	El Bosque	1
1	5894.49023438000	2	El Bosque	1
1	6128.58642578000	2	El Bosque	1
1	9837.39257813000	2	El Bosque	1
1	6157.22509766000	2	El Bosque	1
1	6196.87109375000	2	El Bosque	1
1	6603.50146484000	2	El Bosque	1
1	6121.21386719000	2	El Bosque	1
1	5976.34179688000	2	El Bosque	1
1	6042.19873047000	2	El Bosque	1
1	6045.24267578000	2	El Bosque	1
1	5927.91894531000	2	El Bosque	1
1	5618.92236328000	2	El Bosque	1
1	5754.20654297000	2	El Bosque	1
1	9551.67871094000	2	El Bosque	1
1	7005.27978516000	2	El Bosque	1
1	6843.54980469000	2	El Bosque	1
1	5806.39941406000	2	El Bosque	1
1	5694.59277344000	2	El Bosque	1
1	6508.64160156000	2	El Bosque	1
1	5549.46923828000	2	El Bosque	1
1	5849.17724609000	2	El Bosque	1
1	5620.34521484000	2	El Bosque	1

1	5534.98535156000	2	El Bosque	1
1	5498.43359375000	2	El Bosque	1
1	5741.57568359000	2	El Bosque	1
1	5468.03857422000	2	El Bosque	1
1	5297.52783203000	2	El Bosque	1
1	8504.51171875000	2	El Bosque	1
1	5308.82910156000	2	El Bosque	1
1	8630.94726563000	2	El Bosque	1
1	6229.08154297000	2	El Bosque	1
1	4965.11083984000	2	El Bosque	1
1	6532.68554688000	2	El Bosque	1
1	5234.67333984000	2	El Bosque	1
1	4766.78466797000	2	El Bosque	1
1	4998.28515625000	2	El Bosque	1
1	5165.86230469000	2	El Bosque	1
1	5203.92871094000	2	El Bosque	1
1	4956.43115234000	2	El Bosque	1
1	8702.23925781000	2	El Bosque	1
1	7685.02587891000	2	El Bosque	1
1	5675.47119141000	2	El Bosque	1
1	4875.83203125000	2	El Bosque	1
1	4833.01171875000	2	El Bosque	1
1	8766.90429688000	2	El Bosque	1
1	4732.78808594000	2	El Bosque	1
1	4508.50000000000	2	El Bosque	1
1	7080.85546875000	2	El Bosque	1
1	4425.42822266000	2	El Bosque	1
1	8490.73046875000	2	El Bosque	1
1	4494.05761719000	2	El Bosque	1
1	4494.60546875000	2	El Bosque	1
1	6675.45703125000	2	El Bosque	1
1	7419.29833984000	2	El Bosque	1
1	9230.65136719000	2	El Bosque	1
1	7980.05224609000	2	El Bosque	1
1	4380.00585938000	2	El Bosque	1
1	6788.01757813000	2	El Bosque	1
1	7580.33349609000	2	El Bosque	1
1	4368.88964844000	2	El Bosque	1
1	9277.02636719000	2	El Bosque	1
1	4192.38867188000	2	El Bosque	1
1	7188.60595703000	2	El Bosque	1
1	6960.96533203000	2	El Bosque	1
1	4218.08496094000	2	El Bosque	1
1	7521.17041016000	2	El Bosque	1
1	8265.79296875000	2	El Bosque	1
1	4060.27905273000	2	El Bosque	1
1	7626.47607422000	2	El Bosque	1
1	4342.82958984000	2	El Bosque	1
1	4310.04589844000	2	El Bosque	1

1	4156.32910156000	2	El Bosque	1
1	7303.22851563000	2	El Bosque	1
1	4222.40917969000	2	El Bosque	1
1	9217.28613281000	2	El Bosque	1
1	3692.71972656000	2	El Bosque	1
1	3742.00732422000	2	El Bosque	1
1	3538.78979492000	2	El Bosque	1
1	3940.72265625000	2	El Bosque	1
1	3643.77392578000	2	El Bosque	1
1	3924.51757813000	2	El Bosque	1
1	3622.31176758000	2	El Bosque	1
1	3719.69311523000	2	El Bosque	1
1	3674.22924805000	2	El Bosque	1
1	3901.54663086000	2	El Bosque	1
1	3841.12915039000	2	El Bosque	1
1	3809.97167969000	2	El Bosque	1
1	3529.83764648000	2	El Bosque	1
1	3557.55639648000	2	El Bosque	1
1	3409.64794922000	2	El Bosque	1
1	3818.68920898000	2	El Bosque	1
1	3704.67211914000	2	El Bosque	1
1	3305.54199219000	2	El Bosque	1
1	3423.80249023000	2	El Bosque	1
1	3239.64501953000	2	El Bosque	1
1	3425.47924805000	2	El Bosque	1
1	3444.27026367000	2	El Bosque	1
1	4415.77783203000	2	El Bosque	1
1	3691.75366211000	2	El Bosque	1
1	3138.09155273000	2	El Bosque	1
1	3261.36572266000	2	El Bosque	1
1	3104.02050781000	2	El Bosque	1
1	3169.24780273000	2	El Bosque	1
1	3086.82031250000	2	El Bosque	1
1	3126.22436523000	2	El Bosque	1
1	3484.79907227000	2	El Bosque	1
1	2873.50439453000	2	El Bosque	1
1	3023.56396484000	2	El Bosque	1
1	3639.09545898000	2	El Bosque	1
1	3002.54125977000	2	El Bosque	1
1	2979.53955078000	2	El Bosque	1
1	7984.39746094000	2	El Bosque	1
1	8007.61816406000	2	El Bosque	1
1	3254.70068359000	2	El Bosque	1
1	3116.43774414000	2	El Bosque	1
1	3400.85107422000	2	El Bosque	1
1	3040.57861328000	2	El Bosque	1
1	8893.20605469000	2	El Bosque	1
1	3081.10498047000	2	El Bosque	1
1	2958.08862305000	2	El Bosque	1

1	6892.56250000000	2	El Bosque	1
1	6311.99951172000	2	El Bosque	1
1	2992.70336914000	2	El Bosque	1
1	3450.17993164000	2	El Bosque	1
1	9541.44824219000	2	El Bosque	1
1	6690.80029297000	2	El Bosque	1
1	3468.90747070000	2	El Bosque	1
1	9184.78417969000	2	El Bosque	1
1	2876.06323242000	2	El Bosque	1
1	8530.07031250000	2	El Bosque	1
1	8781.35058594000	2	El Bosque	1
1	5983.64208984000	2	El Bosque	1
1	3449.30444336000	2	El Bosque	1
1	6234.62988281000	2	El Bosque	1
1	8223.91503906000	2	El Bosque	1
1	8971.13378906000	2	El Bosque	1
1	6299.92724609000	2	El Bosque	1
1	8198.41796875000	2	El Bosque	1
1	5774.14550781000	2	El Bosque	1
1	8244.98925781000	2	El Bosque	1
1	9440.07421875000	2	El Bosque	1
1	6121.18261719000	2	El Bosque	1
1	8549.93164063000	2	El Bosque	1
1	5400.46777344000	2	El Bosque	1
1	9236.56738281000	2	El Bosque	1
1	6217.00537109000	2	El Bosque	1
1	5888.64892578000	2	El Bosque	1
1	7392.91894531000	2	El Bosque	1
1	9598.29199219000	2	El Bosque	1
1	5144.92724609000	2	El Bosque	1
1	5446.09472656000	2	El Bosque	1
1	2699.40966797000	2	El Bosque	1
1	1765.78405762000	2	El Bosque	1
1	5626.60253906000	2	El Bosque	1
1	9651.05468750000	2	El Bosque	1
1	9186.68554688000	2	El Bosque	1
1	9249.09375000000	2	El Bosque	1
1	3761.82275391000	2	El Bosque	1
1	7392.55908203000	2	El Bosque	1
1	4958.76953125000	2	El Bosque	1
1	1466.14074707000	2	El Bosque	1
1	2522.68359375000	2	El Bosque	1
1	1773.08105469000	2	El Bosque	1
1	8573.06054688000	2	El Bosque	1
1	4008.96826172000	2	El Bosque	1
1	1321.15771484000	2	El Bosque	1
1	7402.83007813000	2	El Bosque	1
1	4392.72119141000	2	El Bosque	1
1	2473.48974609000	2	El Bosque	1

1	3512.80834961000	2	El Bosque	1
1	3785.87646484000	2	El Bosque	1
1	1271.52441406000	2	El Bosque	1
1	4223.00000000000	2	El Bosque	1
1	9695.61816406000	2	El Bosque	1
1	1526.96264648000	2	El Bosque	1
1	8822.50195313000	2	El Bosque	1
1	4121.23046875000	2	El Bosque	1
1	9893.90820313000	2	El Bosque	1
1	4997.47802734000	2	El Bosque	1
1	1028.95825195000	2	El Bosque	1
1	4204.20458984000	2	El Bosque	1
1	8519.31933594000	2	El Bosque	1
1	1460.68359375000	2	El Bosque	1
1	4589.72070313000	2	El Bosque	1
1	8889.82519531000	2	El Bosque	1
1	9744.37011719000	2	El Bosque	1
1	942.98645019500	2	El Bosque	1
1	7303.73437500000	2	El Bosque	1
1	1269.96264648000	2	El Bosque	1
1	813.71093750000	2	El Bosque	1
1	4351.77832031000	2	El Bosque	1
1	6206.90673828000	2	El Bosque	1
1	5721.92968750000	2	El Bosque	1
1	823.15118408200	2	El Bosque	1
1	1335.37280273000	2	El Bosque	1
1	1162.91601563000	2	El Bosque	1
1	9612.13281250000	2	El Bosque	1
1	2395.27050781000	2	El Bosque	1
1	7056.48144531000	2	El Bosque	1
1	1029.74291992000	2	El Bosque	1
1	4706.14648438000	2	El Bosque	1
1	1131.30981445000	2	El Bosque	1
1	679.20172119100	2	El Bosque	1
1	3430.59594727000	2	El Bosque	1
1	4362.49755859000	2	El Bosque	1
1	1403.68518066000	2	El Bosque	1
1	3674.18627930000	2	El Bosque	1
1	8528.78417969000	2	El Bosque	1
1	3572.11401367000	2	El Bosque	1
1	404.00003051800	2	El Bosque	1
1	5438.12988281000	2	El Bosque	1
1	932.61682128900	2	El Bosque	1
1	2268.33496094000	2	El Bosque	1
1	1022.37542725000	2	El Bosque	1
1	3151.99121094000	2	El Bosque	1
1	2805.15258789000	2	El Bosque	1
1	319.38916015600	2	El Bosque	1
1	3496.30664063000	2	El Bosque	1

1	849.46624755900	2	El Bosque	1
1	2049.18652344000	2	El Bosque	1
1	875.59179687500	2	El Bosque	1
1	1817.62377930000	2	El Bosque	1
1	643.22296142600	2	El Bosque	1
1	4945.40087891000	2	El Bosque	1
1	9984.91406250000	2	El Bosque	1
1	1356.23449707000	2	El Bosque	1
1	654.21197509800	2	El Bosque	1
1	3555.71386719000	2	El Bosque	1
1	3993.91357422000	2	El Bosque	1
1	10056.82031250000	2	El Bosque	1
1	280.60009765600	2	El Bosque	1
1	1285.56384277000	2	El Bosque	1
1	128.23652648900	2	El Bosque	1
1	5.39460706711	2	El Bosque	1
1	483.50628662100	2	El Bosque	1
1	1365.67736816000	2	El Bosque	1
1	1586.82312012000	2	El Bosque	1
1	6388.21191406000	2	El Bosque	1
1	3561.48852539000	2	El Bosque	1
1	2879.77612305000	2	El Bosque	1
1	3655.60229492000	2	El Bosque	1
1	6627.17236328000	2	El Bosque	1
1	1732.66882324000	2	El Bosque	1
1	4216.54394531000	2	El Bosque	1
1	1561.40466309000	2	El Bosque	1
1	7038.43798828000	2	El Bosque	1
1	495.06677246100	2	El Bosque	1
1	8838.03125000000	2	El Bosque	1
1	894.43756103500	2	El Bosque	1
1	8100.99414063000	2	El Bosque	1
1	1170.71777344000	2	El Bosque	1
1	2736.17944336000	2	El Bosque	1
1	3207.62011719000	2	El Bosque	1
1	10630.42285160000	2	El Bosque	1
1	10391.16308590000	2	El Bosque	1
1	2997.83642578000	2	El Bosque	1
1	2454.37377930000	2	El Bosque	1
1	8684.67480469000	2	El Bosque	1
1	7036.48144531000	2	El Bosque	1
1	6366.25195313000	2	El Bosque	1
1	7018.17187500000	2	El Bosque	1
1	10343.84179690000	2	El Bosque	1
1	6064.63232422000	2	El Bosque	1
1	7117.99267578000	2	El Bosque	1
1	5036.23730469000	2	El Bosque	1
1	6199.96142578000	2	El Bosque	1
1	3066.40942383000	2	El Bosque	1

1	3202.92456055000	2	El Bosque	1
1	1920.63940430000	2	El Bosque	1
1	2067.60742188000	2	El Bosque	1
1	10433.39257810000	2	El Bosque	1
1	6791.84228516000	2	El Bosque	1
1	3528.10766602000	2	El Bosque	1
1	2720.85058594000	2	El Bosque	1
1	7418.82324219000	2	El Bosque	1
1	5223.75390625000	2	El Bosque	1
1	8659.43164063000	2	El Bosque	1
1	5751.76269531000	2	El Bosque	1
1	6712.84423828000	2	El Bosque	1
1	2231.57568359000	2	El Bosque	1
1	6249.44335938000	2	El Bosque	1
1	2833.64770508000	2	El Bosque	1
1	7883.12597656000	2	El Bosque	1
1	12107.38183590000	2	El Bosque	1
1	1961.63598633000	2	El Bosque	1
1	10702.71289060000	2	El Bosque	1
1	7837.85839844000	2	El Bosque	1
1	12148.72363280000	2	El Bosque	1
1	11790.13671880000	2	El Bosque	1
1	11273.52441410000	2	El Bosque	1
1	6078.20361328000	2	El Bosque	1
1	8072.99267578000	2	El Bosque	1
1	3316.21923828000	2	El Bosque	1
1	2995.59838867000	2	El Bosque	1
1	8447.76074219000	2	El Bosque	1
1	8549.41308594000	2	El Bosque	1
1	11848.97070310000	2	El Bosque	1
1	8663.66210938000	2	El Bosque	1
1	9233.35644531000	2	El Bosque	1
1	8684.77246094000	2	El Bosque	1
1	8848.00781250000	2	El Bosque	1
1	9319.94726563000	2	El Bosque	1
1	9770.21972656000	2	El Bosque	1
1	9739.70800781000	2	El Bosque	1
1	9464.94921875000	2	El Bosque	1
1	9543.40136719000	2	El Bosque	1
1	9462.68164063000	2	El Bosque	1
1	10158.25000000000	2	El Bosque	1
1	10177.58203130000	2	El Bosque	1
1	10163.10937500000	2	El Bosque	1
1	10635.84960940000	2	El Bosque	1
1	10879.67968750000	2	El Bosque	1
1	11562.72851560000	2	El Bosque	1
1	11940.15234380000	2	El Bosque	1
1	11251.76855470000	2	El Bosque	1
1	12096.53613280000	2	El Bosque	1

1	11495.41015630000	2	El Bosque	1
1	12269.20800780000	2	El Bosque	1
1	12672.68750000000	2	El Bosque	1
1	12687.62207030000	2	El Bosque	1
1	13194.10351560000	2	El Bosque	1
1	13563.56445310000	2	El Bosque	1
1	13965.00292970000	2	El Bosque	1
1	13325.62988280000	2	El Bosque	1
1	12720.27929690000	2	El Bosque	1
1	13992.00195310000	2	El Bosque	1
1	13740.84179690000	2	El Bosque	1
1	13746.50585940000	2	El Bosque	1
1	12665.81835940000	2	El Bosque	1
1	15204.70312500000	2	El Bosque	1
1	13142.53320310000	2	El Bosque	2
1	12901.62304690000	2	El Bosque	2
1	12524.55566410000	2	El Bosque	2
1	12830.62402340000	2	El Bosque	2
1	10714.53710940000	2	El Bosque	2
1	10789.88378910000	2	El Bosque	2
1	10694.53027340000	2	El Bosque	2
1	10494.56152340000	2	El Bosque	2
1	10298.21386720000	2	El Bosque	2
1	9993.61328125000	2	El Bosque	2
1	10431.03613280000	2	El Bosque	2
1	9638.75390625000	2	El Bosque	2
1	10050.28027340000	2	El Bosque	2
1	8935.12988281000	2	El Bosque	2
1	8623.75781250000	2	El Bosque	2
1	8689.19238281000	2	El Bosque	2
1	7628.61425781000	2	El Bosque	2
1	7607.02099609000	2	El Bosque	2
1	7322.88330078000	2	El Bosque	2
1	6863.47753906000	2	El Bosque	2
1	6702.21533203000	2	El Bosque	2
1	6374.45947266000	2	El Bosque	2
1	6670.82031250000	2	El Bosque	2
1	6433.77636719000	2	El Bosque	2
1	6394.37744141000	2	El Bosque	2
1	6229.11962891000	2	El Bosque	2
1	5901.91210938000	2	El Bosque	2
1	6164.17675781000	2	El Bosque	2
1	5969.55273438000	2	El Bosque	2
1	5425.14257813000	2	El Bosque	2
1	5534.64013672000	2	El Bosque	2
1	6378.75634766000	2	El Bosque	2
1	5353.43408203000	2	El Bosque	2
1	5193.80712891000	2	El Bosque	2
1	5205.87158203000	2	El Bosque	2

1	4696.20312500000	2	El Bosque	2
1	9125.61328125000	2	El Bosque	2
1	4584.31445313000	2	El Bosque	2
1	4545.10546875000	2	El Bosque	2
1	4401.54638672000	2	El Bosque	2
1	7400.11035156000	2	El Bosque	2
1	4312.53271484000	2	El Bosque	2
1	4450.91943359000	2	El Bosque	2
1	4078.17822266000	2	El Bosque	2
1	4188.43066406000	2	El Bosque	2
1	3888.90234375000	2	El Bosque	2
1	3714.66235352000	2	El Bosque	2
1	3746.02099609000	2	El Bosque	2
1	3949.20434570000	2	El Bosque	2
1	3931.24169922000	2	El Bosque	2
1	3927.25488281000	2	El Bosque	2
1	3649.09252930000	2	El Bosque	2
1	4132.73583984000	2	El Bosque	2
1	3925.51245117000	2	El Bosque	2
1	3464.88427734000	2	El Bosque	2
1	3298.68286133000	2	El Bosque	2
1	3710.19458008000	2	El Bosque	2
1	8609.13281250000	2	El Bosque	2
1	3313.51416016000	2	El Bosque	2
1	3314.62866211000	2	El Bosque	2
1	3590.39843750000	2	El Bosque	2
1	3268.77783203000	2	El Bosque	2
1	7949.83544922000	2	El Bosque	2
1	3258.83276367000	2	El Bosque	2
1	3801.49853516000	2	El Bosque	2
1	3279.81835938000	2	El Bosque	2
1	3039.85961914000	2	El Bosque	2
1	3782.46533203000	2	El Bosque	2
1	9060.89355469000	2	El Bosque	2
1	2754.72778320000	2	El Bosque	2
1	2922.02734375000	2	El Bosque	2
1	2974.36621094000	2	El Bosque	2
1	6224.38427734000	2	El Bosque	2
1	3216.79956055000	2	El Bosque	2
1	7986.14501953000	2	El Bosque	2
1	2228.86791992000	2	El Bosque	2
1	2079.92431641000	2	El Bosque	2
1	2670.52905273000	2	El Bosque	2
1	8482.30957031000	2	El Bosque	2
1	1956.78088379000	2	El Bosque	2
1	2947.47436523000	2	El Bosque	2
1	1693.14025879000	2	El Bosque	2
1	1580.81970215000	2	El Bosque	2
1	3583.97631836000	2	El Bosque	2

1	5988.16748047000	2	El Bosque	2
1	1973.84924316000	2	El Bosque	2
1	1537.84948730000	2	El Bosque	2
1	1133.15161133000	2	El Bosque	2
1	978.77655029300	2	El Bosque	2
1	1872.74523926000	2	El Bosque	2
1	787.04650878900	2	El Bosque	2
1	1224.23889160000	2	El Bosque	2
1	851.95312500000	2	El Bosque	2
1	365.26992797900	2	El Bosque	2
1	3147.94018555000	2	El Bosque	2
1	903.25177002000	2	El Bosque	2
1	110.40448761000	2	El Bosque	2
1	753.67083740200	2	El Bosque	2
1	434.05221557600	2	El Bosque	2
1	128.78378295900	2	El Bosque	2
1	3196.04638672000	2	El Bosque	2
1	10638.11035160000	2	El Bosque	2
1	3282.41333008000	2	El Bosque	2
1	1401.62536621000	2	El Bosque	2
1	9588.78906250000	2	El Bosque	2
1	3393.67919922000	2	El Bosque	2
1	8315.21386719000	2	El Bosque	2
1	8298.60058594000	2	El Bosque	2
1	8492.00878906000	2	El Bosque	2
1	8604.20312500000	2	El Bosque	2
1	10343.23925780000	2	El Bosque	3
1	9639.60742188000	2	El Bosque	3
1	7006.08447266000	2	El Bosque	3
1	6736.47705078000	2	El Bosque	3
1	5303.65234375000	2	El Bosque	3
1	4023.76025391000	2	El Bosque	3
1	4474.93505859000	2	El Bosque	3
1	4031.89501953000	2	El Bosque	3
1	4022.20629883000	2	El Bosque	3
1	4113.55810547000	2	El Bosque	3
1	3665.11059570000	2	El Bosque	3
1	3818.80444336000	2	El Bosque	3
1	3493.05224609000	2	El Bosque	3
1	3181.09326172000	2	El Bosque	3
1	8330.32519531000	2	El Bosque	3
1	3302.85058594000	2	El Bosque	3
1	3632.53271484000	2	El Bosque	3
1	2260.41674805000	2	El Bosque	3
1	3426.24487305000	2	El Bosque	3
1	2067.70703125000	2	El Bosque	3
1	8699.61230469000	2	El Bosque	3
1	899.91986084000	2	El Bosque	3
1	656.63726806600	2	El Bosque	3

1	7400.99414063000	2	El Bosque	3
1	9726.67285156000	2	El Bosque	3
1	5052.13085938000	2	El Bosque	4
1	4753.54492188000	2	El Bosque	4
1	4720.48193359000	2	El Bosque	4
1	3497.28588867000	2	El Bosque	4
1	3304.83911133000	2	El Bosque	4
1	3494.36889648000	2	El Bosque	4
1	3902.50781250000	2	El Bosque	4
1	2889.16137695000	2	El Bosque	4
1	8806.72558594000	2	El Bosque	4
1	2615.55908203000	2	El Bosque	4
1	2816.16528320000	2	El Bosque	4
1	4473.22265625000	2	El Bosque	4
1	2116.70141602000	2	El Bosque	4
1	1866.10693359000	2	El Bosque	4
1	1668.28820801000	2	El Bosque	4
1	591.82324218800	2	El Bosque	4

Source Site: Group 10J-1

Start Type	Pathcosts	Zone	***Sian Otot***	End Type
1	12967.24902340000	3	Comedero	1
1	13064.30273440000	3	Comedero	1
1	12841.42089840000	3	Comedero	1
1	12770.69238280000	3	Comedero	1
1	12402.55371090000	3	Comedero	1
1	13982.46875000000	3	Comedero	1
1	11847.74316410000	3	Comedero	1
1	13751.10449220000	3	Comedero	1
1	12294.71484380000	3	Comedero	1
1	11344.39550780000	3	Comedero	1
1	12134.45410160000	3	Comedero	1
1	11769.98144530000	3	Comedero	1
1	11730.86523440000	3	Comedero	1
1	11728.42382810000	3	Comedero	1
1	11610.40527340000	3	Comedero	1
1	11474.67285160000	3	Comedero	1
1	11441.88281250000	3	Comedero	1
1	12182.04785160000	3	Comedero	1
1	12341.17480470000	3	Comedero	1
1	11199.60742190000	3	Comedero	1
1	11023.90820310000	3	Comedero	1
1	10361.67968750000	3	Comedero	1
1	12129.21777340000	3	Comedero	1
1	10542.80566410000	3	Comedero	1
1	11264.49609380000	3	Comedero	1
1	10694.16406250000	3	Comedero	1
1	10909.47851560000	3	Comedero	1

1	10448.87207030000	3	Comedero	1
1	10459.17968750000	3	Comedero	1
1	10477.76074220000	3	Comedero	1
1	10324.11035160000	3	Comedero	1
1	10365.75878910000	3	Comedero	1
1	10107.99511720000	3	Comedero	1
1	9851.49414063000	3	Comedero	1
1	10795.79589840000	3	Comedero	1
1	10135.11523440000	3	Comedero	1
1	9802.48535156000	3	Comedero	1
1	10064.80957030000	3	Comedero	1
1	9993.98242188000	3	Comedero	1
1	9876.86914063000	3	Comedero	1
1	9908.40625000000	3	Comedero	1
1	10039.14453130000	3	Comedero	1
1	9939.05175781000	3	Comedero	1
1	9814.17480469000	3	Comedero	1
1	9731.77441406000	3	Comedero	1
1	11565.14550780000	3	Comedero	1
1	11774.39843750000	3	Comedero	1
1	9469.26269531000	3	Comedero	1
1	9862.41503906000	3	Comedero	1
1	9550.40234375000	3	Comedero	1
1	9763.75000000000	3	Comedero	1
1	9731.22656250000	3	Comedero	1
1	9417.45214844000	3	Comedero	1
1	9783.11328125000	3	Comedero	1
1	9715.73828125000	3	Comedero	1
1	9167.49316406000	3	Comedero	1
1	9015.00781250000	3	Comedero	1
1	8826.78417969000	3	Comedero	1
1	8852.95214844000	3	Comedero	1
1	8652.66406250000	3	Comedero	1
1	8502.95117188000	3	Comedero	1
1	8200.22363281000	3	Comedero	1
1	8035.95019531000	3	Comedero	1
1	7925.18701172000	3	Comedero	1
1	7811.38085938000	3	Comedero	1
1	7881.77099609000	3	Comedero	1
1	7714.09033203000	3	Comedero	1
1	7737.25634766000	3	Comedero	1
1	7556.31933594000	3	Comedero	1
1	8226.08496094000	3	Comedero	1
1	7841.13623047000	3	Comedero	1
1	7764.22558594000	3	Comedero	1
1	7264.08544922000	3	Comedero	1
1	7369.06689453000	3	Comedero	1
1	7414.78173828000	3	Comedero	1
1	7309.32568359000	3	Comedero	1
1	6201.26562500000	3	Comedero	1
1	6599.86425781000	3	Comedero	1

1	6056.71484375000	3	Comedero	1
1	6023.28417969000	3	Comedero	1
1	6879.37207031000	3	Comedero	1
1	6953.82617188000	3	Comedero	1
1	6327.11425781000	3	Comedero	1
1	6725.32177734000	3	Comedero	1
1	6241.33154297000	3	Comedero	1
1	6695.95410156000	3	Comedero	1
1	6282.89208984000	3	Comedero	1
1	6185.64013672000	3	Comedero	1
1	6443.86669922000	3	Comedero	1
1	6258.84326172000	3	Comedero	1
1	9397.60449219000	3	Comedero	1
1	5805.56884766000	3	Comedero	1
1	5916.99902344000	3	Comedero	1
1	5705.79443359000	3	Comedero	1
1	5520.88281250000	3	Comedero	1
1	6204.19189453000	3	Comedero	1
1	4747.16601563000	3	Comedero	1
1	5675.53710938000	3	Comedero	1
1	5592.07373047000	3	Comedero	1
1	5553.14257813000	3	Comedero	1
1	5894.36474609000	3	Comedero	1
1	5327.27783203000	3	Comedero	1
1	6736.65185547000	3	Comedero	1
1	4595.07226563000	3	Comedero	1
1	4331.98144531000	3	Comedero	1
1	6255.74169922000	3	Comedero	1
1	6520.14746094000	3	Comedero	1
1	8644.60449219000	3	Comedero	1
1	7492.42675781000	3	Comedero	1
1	5461.40087891000	3	Comedero	1
1	4471.98779297000	3	Comedero	1
1	5466.49707031000	3	Comedero	1
1	5151.19824219000	3	Comedero	1
1	5176.39404297000	3	Comedero	1
1	9094.09765625000	3	Comedero	1
1	5413.93066406000	3	Comedero	1
1	5453.57666016000	3	Comedero	1
1	5860.20800781000	3	Comedero	1
1	4156.82421875000	3	Comedero	1
1	4211.43994141000	3	Comedero	1
1	5298.90332031000	3	Comedero	1
1	4363.81982422000	3	Comedero	1
1	5184.62451172000	3	Comedero	1
1	4875.63037109000	3	Comedero	1
1	5010.91210938000	3	Comedero	1
1	8808.38964844000	3	Comedero	1
1	6261.98583984000	3	Comedero	1
1	6100.25585938000	3	Comedero	1
1	5063.10302734000	3	Comedero	1

1	3902.86621094000	3	Comedero	1
1	5765.34765625000	3	Comedero	1
1	3933.94091797000	3	Comedero	1
1	4657.76367188000	3	Comedero	1
1	4877.05078125000	3	Comedero	1
1	4791.69091797000	3	Comedero	1
1	4755.13916016000	3	Comedero	1
1	4998.28027344000	3	Comedero	1
1	4724.74414063000	3	Comedero	1
1	4554.23583984000	3	Comedero	1
1	7761.21777344000	3	Comedero	1
1	3131.00415039000	3	Comedero	1
1	7887.65283203000	3	Comedero	1
1	5485.78808594000	3	Comedero	1
1	4221.81689453000	3	Comedero	1
1	5789.39062500000	3	Comedero	1
1	2884.90478516000	3	Comedero	1
1	4023.48974609000	3	Comedero	1
1	4205.12304688000	3	Comedero	1
1	3291.87670898000	3	Comedero	1
1	3719.29809570000	3	Comedero	1
1	4213.13720703000	3	Comedero	1
1	7958.95068359000	3	Comedero	1
1	4762.30615234000	3	Comedero	1
1	4932.17773438000	3	Comedero	1
1	4062.88281250000	3	Comedero	1
1	4089.71606445000	3	Comedero	1
1	8023.61181641000	3	Comedero	1
1	3789.06298828000	3	Comedero	1
1	3765.20458984000	3	Comedero	1
1	4158.13769531000	3	Comedero	1
1	3655.27587891000	3	Comedero	1
1	5769.28222656000	3	Comedero	1
1	3750.76049805000	3	Comedero	1
1	3751.31201172000	3	Comedero	1
1	5932.16210938000	3	Comedero	1
1	6676.00341797000	3	Comedero	1
1	8487.36425781000	3	Comedero	1
1	5180.81738281000	3	Comedero	1
1	3478.73559570000	3	Comedero	1
1	3865.29907227000	3	Comedero	1
1	6837.03857422000	3	Comedero	1
1	3625.59570313000	3	Comedero	1
1	8533.74121094000	3	Comedero	1
1	2986.51684570000	3	Comedero	1
1	4265.88574219000	3	Comedero	1
1	4038.24218750000	3	Comedero	1
1	2858.83325195000	3	Comedero	1
1	4614.98486328000	3	Comedero	1
1	7522.49951172000	3	Comedero	1
1	2926.06420898000	3	Comedero	1

1	4905.02880859000	3	Comedero	1
1	1534.30639648000	3	Comedero	1
1	3566.75146484000	3	Comedero	1
1	3413.03491211000	3	Comedero	1
1	4469.19482422000	3	Comedero	1
1	3479.11401367000	3	Comedero	1
1	8637.83886719000	3	Comedero	1
1	2382.77832031000	3	Comedero	1
1	2998.71240234000	3	Comedero	1
1	2404.71215820000	3	Comedero	1
1	1184.09460449000	3	Comedero	1
1	2705.55322266000	3	Comedero	1
1	3181.22290039000	3	Comedero	1
1	2879.01684570000	3	Comedero	1
1	2976.39819336000	3	Comedero	1
1	2803.23217773000	3	Comedero	1
1	1397.87695313000	3	Comedero	1
1	1997.88037109000	3	Comedero	1
1	3066.67700195000	3	Comedero	1
1	1853.98254395000	3	Comedero	1
1	2686.55932617000	3	Comedero	1
1	2666.35302734000	3	Comedero	1
1	3075.39453125000	3	Comedero	1
1	2961.37719727000	3	Comedero	1
1	2007.61682129000	3	Comedero	1
1	2680.50756836000	3	Comedero	1
1	1841.61950684000	3	Comedero	1
1	1554.10327148000	3	Comedero	1
1	1467.00195313000	3	Comedero	1
1	1493.05798340000	3	Comedero	1
1	2948.45898438000	3	Comedero	1
1	2394.79663086000	3	Comedero	1
1	435.27954101600	3	Comedero	1
1	2360.72558594000	3	Comedero	1
1	2425.95288086000	3	Comedero	1
1	2215.82397461000	3	Comedero	1
1	2382.92944336000	3	Comedero	1
1	2741.50439453000	3	Comedero	1
1	2002.50817871000	3	Comedero	1
1	643.84515380900	3	Comedero	1
1	2895.80078125000	3	Comedero	1
1	925.99871826200	3	Comedero	1
1	2108.54370117000	3	Comedero	1
1	6227.65917969000	3	Comedero	1
1	7518.31738281000	3	Comedero	1
1	150.04698181200	3	Comedero	1
1	2245.44018555000	3	Comedero	1
1	2297.28369141000	3	Comedero	1
1	7136.46630859000	3	Comedero	1
1	246.81405639600	3	Comedero	1
1	2214.79394531000	3	Comedero	1

1	6308.47558594000	3	Comedero	1
1	4181.95703125000	3	Comedero	1
1	352.72732543900	3	Comedero	1
1	7784.70898438000	3	Comedero	1
1	6106.71337891000	3	Comedero	1
1	7428.04785156000	3	Comedero	1
1	485.50448608400	3	Comedero	1
1	6773.33349609000	3	Comedero	1
1	7024.60693359000	3	Comedero	1
1	4073.55297852000	3	Comedero	1
1	674.62805175800	3	Comedero	1
1	5650.54296875000	3	Comedero	1
1	6470.59082031000	3	Comedero	1
1	8730.82324219000	3	Comedero	1
1	5717.31298828000	3	Comedero	1
1	6445.09375000000	3	Comedero	1
1	5268.10400391000	3	Comedero	1
1	6491.66162109000	3	Comedero	1
1	7686.74365234000	3	Comedero	1
1	4361.02001953000	3	Comedero	1
1	6796.60839844000	3	Comedero	1
1	3570.35449219000	3	Comedero	1
1	9176.98144531000	3	Comedero	1
1	5903.12304688000	3	Comedero	1
1	5527.74511719000	3	Comedero	1
1	7288.33935547000	3	Comedero	1
1	7844.95996094000	3	Comedero	1
1	4828.58496094000	3	Comedero	1
1	5145.97363281000	3	Comedero	1
1	514.35516357400	3	Comedero	1
1	1288.08679199000	3	Comedero	1
1	5408.13427734000	3	Comedero	1
1	7905.87304688000	3	Comedero	1
1	9225.56738281000	3	Comedero	1
1	7503.91455078000	3	Comedero	1
1	4002.38183594000	3	Comedero	1
1	7407.11132813000	3	Comedero	1
1	3198.59985352000	3	Comedero	1
1	1435.80981445000	3	Comedero	1
1	690.28869628900	3	Comedero	1
1	1202.13916016000	3	Comedero	1
1	6827.87500000000	3	Comedero	1
1	4364.11425781000	3	Comedero	1
1	1658.69750977000	3	Comedero	1
1	7420.62988281000	3	Comedero	1
1	2388.26342773000	3	Comedero	1
1	726.00488281300	3	Comedero	1
1	4073.98291016000	3	Comedero	1
1	4263.26074219000	3	Comedero	1
1	1420.98583984000	3	Comedero	1
1	2196.64086914000	3	Comedero	1

1	7950.43847656000	3	Comedero	1
1	1272.51208496000	3	Comedero	1
1	8997.86230469000	3	Comedero	1
1	4680.15869141000	3	Comedero	1
1	8148.72900391000	3	Comedero	1
1	5276.79052734000	3	Comedero	1
1	1675.78662109000	3	Comedero	1
1	2405.92358398000	3	Comedero	1
1	6774.13623047000	3	Comedero	1
1	1249.31677246000	3	Comedero	1
1	5052.01367188000	3	Comedero	1
1	7144.63818359000	3	Comedero	1
1	7999.19042969000	3	Comedero	1
1	1807.89697266000	3	Comedero	1
1	7609.07812500000	3	Comedero	1
1	1368.36413574000	3	Comedero	1
1	1690.75183105000	3	Comedero	1
1	2591.60864258000	3	Comedero	1
1	6597.55419922000	3	Comedero	1
1	6091.74951172000	3	Comedero	1
1	1527.81408691000	3	Comedero	1
1	1264.85717773000	3	Comedero	1
1	2273.20751953000	3	Comedero	1
1	7866.94384766000	3	Comedero	1
1	1051.26806641000	3	Comedero	1
1	7447.74023438000	3	Comedero	1
1	1453.05529785000	3	Comedero	1
1	5484.43701172000	3	Comedero	1
1	1374.35864258000	3	Comedero	1
1	1921.15637207000	3	Comedero	1
1	4403.17968750000	3	Comedero	1
1	5257.25390625000	3	Comedero	1
1	2579.26123047000	3	Comedero	1
1	4639.02978516000	3	Comedero	1
1	8950.89941406000	3	Comedero	1
1	4573.54492188000	3	Comedero	1
1	1748.23535156000	3	Comedero	1
1	6154.68261719000	3	Comedero	1
1	1429.15478516000	3	Comedero	1
1	1082.14831543000	3	Comedero	1
1	1321.63244629000	3	Comedero	1
1	4503.67822266000	3	Comedero	1
1	4132.33203125000	3	Comedero	1
1	1871.51611328000	3	Comedero	1
1	1455.90222168000	3	Comedero	1
1	1152.25585938000	3	Comedero	1
1	1206.04248047000	3	Comedero	1
1	1598.05102539000	3	Comedero	1
1	6000.50878906000	3	Comedero	1
1	8239.73242188000	3	Comedero	1
1	1160.91369629000	3	Comedero	1

1	1663.25280762000	3	Comedero	1
1	5030.55615234000	3	Comedero	1
1	5333.31494141000	3	Comedero	1
1	8311.64746094000	3	Comedero	1
1	2208.09985352000	3	Comedero	1
1	1243.79687500000	3	Comedero	1
1	1942.49804688000	3	Comedero	1
1	2021.75854492000	3	Comedero	1
1	2471.05859375000	3	Comedero	1
1	1259.34411621000	3	Comedero	1
1	1402.59301758000	3	Comedero	1
1	7339.58740234000	3	Comedero	1
1	5235.71093750000	3	Comedero	1
1	4551.10156250000	3	Comedero	1
1	5300.81591797000	3	Comedero	1
1	7574.72119141000	3	Comedero	1
1	1441.72851563000	3	Comedero	1
1	5628.55810547000	3	Comedero	1
1	1460.68542480000	3	Comedero	1
1	7970.40234375000	3	Comedero	1
1	1881.98913574000	3	Comedero	1
1	9467.66308594000	3	Comedero	1
1	1635.66662598000	3	Comedero	1
1	8936.36621094000	3	Comedero	1
1	1545.17431641000	3	Comedero	1
1	4507.85400391000	3	Comedero	1
1	5025.41015625000	3	Comedero	1
1	8885.25000000000	3	Comedero	1
1	8645.98632813000	3	Comedero	1
1	4903.67919922000	3	Comedero	1
1	4360.21533203000	3	Comedero	1
1	9663.20019531000	3	Comedero	1
1	5291.29833984000	3	Comedero	1
1	4723.29687500000	3	Comedero	1
1	5272.98632813000	3	Comedero	1
1	8598.66503906000	3	Comedero	1
1	4439.03808594000	3	Comedero	1
1	5372.80908203000	3	Comedero	1
1	3452.15478516000	3	Comedero	1
1	4574.36767578000	3	Comedero	1
1	2880.05175781000	3	Comedero	1
1	2864.29931641000	3	Comedero	1
1	3129.57470703000	3	Comedero	1
1	3096.13989258000	3	Comedero	1
1	8688.22753906000	3	Comedero	1
1	5166.25585938000	3	Comedero	1
1	2893.10766602000	3	Comedero	1
1	3208.06396484000	3	Comedero	1
1	5673.64062500000	3	Comedero	1
1	3639.67285156000	3	Comedero	1
1	6914.25000000000	3	Comedero	1

1	4167.67773438000	3	Comedero	1
1	3595.33593750000	3	Comedero	1
1	4665.35888672000	3	Comedero	1
1	3469.18530273000	3	Comedero	1
1	9378.04003906000	3	Comedero	1
1	10362.21289060000	3	Comedero	1
1	3697.02270508000	3	Comedero	1
1	8957.54882813000	3	Comedero	1
1	9332.76953125000	3	Comedero	1
1	10403.55468750000	3	Comedero	1
1	10044.96777340000	3	Comedero	1
1	9528.35546875000	3	Comedero	1
1	4499.95898438000	3	Comedero	1
1	6327.81054688000	3	Comedero	1
1	5336.30566406000	3	Comedero	1
1	4850.71679688000	3	Comedero	1
1	6854.76269531000	3	Comedero	1
1	6956.41113281000	3	Comedero	1
1	10103.78125000000	3	Comedero	1
1	7070.66796875000	3	Comedero	1
1	7488.17773438000	3	Comedero	1
1	7091.77148438000	3	Comedero	1
1	7255.00976563000	3	Comedero	1
1	7726.94531250000	3	Comedero	1
1	8025.02929688000	3	Comedero	1
1	8079.13720703000	3	Comedero	1
1	7871.93750000000	3	Comedero	1
1	7951.49072266000	3	Comedero	1
1	7883.03320313000	3	Comedero	1
1	8414.48828125000	3	Comedero	1
1	8514.27050781000	3	Comedero	1
1	8639.57910156000	3	Comedero	1
1	8922.91113281000	3	Comedero	1
1	9134.49804688000	3	Comedero	1
1	9817.54003906000	3	Comedero	1
1	10194.96386720000	3	Comedero	1
1	9635.50292969000	3	Comedero	1
1	10351.35253910000	3	Comedero	1
1	9876.05273438000	3	Comedero	1
1	10524.02636720000	3	Comedero	1
1	10927.49609380000	3	Comedero	1
1	10942.44042970000	3	Comedero	1
1	11448.91503910000	3	Comedero	1
1	11818.37500000000	3	Comedero	1
1	12219.81347660000	3	Comedero	1
1	11580.44042970000	3	Comedero	1
1	11047.34570310000	3	Comedero	1
1	12246.81250000000	3	Comedero	1
1	11995.65234380000	3	Comedero	1
1	12001.31640630000	3	Comedero	1
1	11186.12500000000	3	Comedero	1

1	13459.51367190000	3	Comedero	1
1	12399.24218750000	3	Comedero	2
1	11473.62890630000	3	Comedero	2
1	11781.26757810000	3	Comedero	2
1	11273.05078130000	3	Comedero	2
1	9971.24609375000	3	Comedero	2
1	10046.59277340000	3	Comedero	2
1	9951.24218750000	3	Comedero	2
1	9751.27050781000	3	Comedero	2
1	9554.92578125000	3	Comedero	2
1	9250.32128906000	3	Comedero	2
1	9687.74804688000	3	Comedero	2
1	8895.46875000000	3	Comedero	2
1	9306.98925781000	3	Comedero	2
1	8191.83593750000	3	Comedero	2
1	7880.46386719000	3	Comedero	2
1	7945.90136719000	3	Comedero	2
1	6034.90039063000	3	Comedero	2
1	6863.72656250000	3	Comedero	2
1	6579.58886719000	3	Comedero	2
1	6120.18310547000	3	Comedero	2
1	4541.93457031000	3	Comedero	2
1	4807.20361328000	3	Comedero	2
1	5716.21630859000	3	Comedero	2
1	5690.48095703000	3	Comedero	2
1	5474.10156250000	3	Comedero	2
1	5425.67626953000	3	Comedero	2
1	5158.61816406000	3	Comedero	2
1	4960.25195313000	3	Comedero	2
1	5226.25683594000	3	Comedero	2
1	3884.50512695000	3	Comedero	2
1	4282.24023438000	3	Comedero	2
1	5635.46289063000	3	Comedero	2
1	4610.13964844000	3	Comedero	2
1	4134.72802734000	3	Comedero	2
1	3665.23095703000	3	Comedero	2
1	3952.90966797000	3	Comedero	2
1	8382.31933594000	3	Comedero	2
1	3683.91723633000	3	Comedero	2
1	3801.81127930000	3	Comedero	2
1	3427.14208984000	3	Comedero	2
1	4477.39013672000	3	Comedero	2
1	3569.23901367000	3	Comedero	2
1	2118.26196289000	3	Comedero	2
1	3334.88354492000	3	Comedero	2
1	1380.17175293000	3	Comedero	2
1	2563.27368164000	3	Comedero	2
1	2552.03710938000	3	Comedero	2
1	2677.63696289000	3	Comedero	2
1	1140.68164063000	3	Comedero	2
1	3187.94702148000	3	Comedero	2

1	3183.95996094000	3	Comedero	2
1	2229.79028320000	3	Comedero	2
1	1230.41882324000	3	Comedero	2
1	3182.21777344000	3	Comedero	2
1	2314.43627930000	3	Comedero	2
1	2310.98852539000	3	Comedero	2
1	2966.89990234000	3	Comedero	2
1	7998.31103516000	3	Comedero	2
1	2570.21923828000	3	Comedero	2
1	1591.43664551000	3	Comedero	2
1	2847.10375977000	3	Comedero	2
1	1428.85620117000	3	Comedero	2
1	7354.95458984000	3	Comedero	2
1	1059.12976074000	3	Comedero	2
1	3058.20385742000	3	Comedero	2
1	864.89996337900	3	Comedero	2
1	1144.00183105000	3	Comedero	2
1	3039.17065430000	3	Comedero	2
1	7304.16503906000	3	Comedero	2
1	1057.75109863000	3	Comedero	2
1	2178.73291016000	3	Comedero	2
1	479.83480835000	3	Comedero	2
1	4133.88525391000	3	Comedero	2
1	2499.01025391000	3	Comedero	2
1	6229.40673828000	3	Comedero	2
1	1103.64990234000	3	Comedero	2
1	1124.22802734000	3	Comedero	2
1	576.84558105500	3	Comedero	2
1	8390.86035156000	3	Comedero	2
1	1272.68334961000	3	Comedero	2
1	531.15478515600	3	Comedero	2
1	1833.00512695000	3	Comedero	2
1	1647.21838379000	3	Comedero	2
1	3953.20214844000	3	Comedero	2
1	5907.93310547000	3	Comedero	2
1	886.20056152300	3	Comedero	2
1	2027.73632813000	3	Comedero	2
1	1924.89611816000	3	Comedero	2
1	1885.77990723000	3	Comedero	2
1	943.28491210900	3	Comedero	2
1	1942.49230957000	3	Comedero	2
1	2425.50830078000	3	Comedero	2
1	2112.97509766000	3	Comedero	2
1	1674.83654785000	3	Comedero	2
1	4474.08691406000	3	Comedero	2
1	2391.01123047000	3	Comedero	2
1	1893.45422363000	3	Comedero	2
1	1674.45422363000	3	Comedero	2
1	1818.73437500000	3	Comedero	2
1	2145.83422852000	3	Comedero	2
1	5101.88867188000	3	Comedero	2

1	8892.93750000000	3	Comedero	2
1	5188.25585938000	3	Comedero	2
1	3019.08959961000	3	Comedero	2
1	7843.61474609000	3	Comedero	2
1	5413.76953125000	3	Comedero	2
1	6570.03125000000	3	Comedero	2
1	6553.42041016000	3	Comedero	2
1	6746.82861328000	3	Comedero	2
1	7008.53662109000	3	Comedero	2
1	9599.95507813000	3	Comedero	3
1	8896.31640625000	3	Comedero	3
1	6262.79003906000	3	Comedero	3
1	5954.87304688000	3	Comedero	3
1	4489.17968750000	3	Comedero	3
1	3280.46533203000	3	Comedero	3
1	3731.64306641000	3	Comedero	3
1	2548.08911133000	3	Comedero	3
1	3278.91162109000	3	Comedero	3
1	3370.26342773000	3	Comedero	3
1	2921.81591797000	3	Comedero	3
1	3075.50976563000	3	Comedero	3
1	2749.75756836000	3	Comedero	3
1	2310.09667969000	3	Comedero	3
1	6573.58740234000	3	Comedero	3
1	2559.55590820000	3	Comedero	3
1	248.52282714800	3	Comedero	3
1	1355.19970703000	3	Comedero	3
1	209.18836975100	3	Comedero	3
1	1451.44836426000	3	Comedero	3
1	6954.42236328000	3	Comedero	3
1	2600.48901367000	3	Comedero	3
1	2636.95532227000	3	Comedero	3
1	5655.81103516000	3	Comedero	3
1	8133.67431641000	3	Comedero	3
1	4168.42187500000	3	Comedero	4
1	4010.24902344000	3	Comedero	4
1	1774.08251953000	3	Comedero	4
1	2615.35278320000	3	Comedero	4
1	514.88488769500	3	Comedero	4
1	2751.07421875000	3	Comedero	4
1	3159.21313477000	3	Comedero	4
1	2145.86669922000	3	Comedero	4
1	7049.97558594000	3	Comedero	4
1	647.70489502000	3	Comedero	4
1	2072.87084961000	3	Comedero	4
1	1715.24047852000	3	Comedero	4
1	943.90173339800	3	Comedero	4
1	1213.79260254000	3	Comedero	4
1	1422.41284180000	3	Comedero	4
1	1655.08752441000	3	Comedero	4

Source Site: Group 10L-3

Start Type	Pathcosts	Zone	*Sian Otot*	End Type
2	13691.36328130000	2	El Bosque	1
2	13697.91796880000	2	El Bosque	1
2	13526.17773440000	2	El Bosque	1
2	13404.30664060000	2	El Bosque	1
2	13036.16796880000	2	El Bosque	1
2	14616.08593750000	2	El Bosque	1
2	12601.84570310000	2	El Bosque	1
2	14384.72167970000	2	El Bosque	1
2	12928.33203130000	2	El Bosque	1
2	12792.82519530000	2	El Bosque	1
2	12768.06835940000	2	El Bosque	1
2	12403.60156250000	2	El Bosque	1
2	12364.47949220000	2	El Bosque	1
2	12362.03808590000	2	El Bosque	1
2	12244.02539060000	2	El Bosque	1
2	12108.29296880000	2	El Bosque	1
2	12075.50292970000	2	El Bosque	1
2	12815.66503910000	2	El Bosque	1
2	12974.79199220000	2	El Bosque	1
2	11833.22460940000	2	El Bosque	1
2	11657.52246090000	2	El Bosque	1
2	11337.36523440000	2	El Bosque	1
2	12762.83496090000	2	El Bosque	1
2	11199.58691410000	2	El Bosque	1
2	11898.11328130000	2	El Bosque	1
2	11327.77734380000	2	El Bosque	1
2	11543.09570310000	2	El Bosque	1
2	11082.48925780000	2	El Bosque	1
2	11092.79687500000	2	El Bosque	1
2	11111.37402340000	2	El Bosque	1
2	10957.72753910000	2	El Bosque	1
2	10999.37207030000	2	El Bosque	1
2	10741.61523440000	2	El Bosque	1
2	10485.10937500000	2	El Bosque	1
2	11429.41308590000	2	El Bosque	1
2	10768.72851560000	2	El Bosque	1
2	10436.10546880000	2	El Bosque	1
2	10698.42675780000	2	El Bosque	1
2	10627.59667970000	2	El Bosque	1
2	10510.48339840000	2	El Bosque	1
2	10542.01953130000	2	El Bosque	1
2	10672.76171880000	2	El Bosque	1
2	10572.66503910000	2	El Bosque	1
2	10447.78906250000	2	El Bosque	1
2	10365.38867190000	2	El Bosque	1
2	12198.76074220000	2	El Bosque	1

2	12408.01367190000	2	El Bosque	1
2	10821.43554690000	2	El Bosque	1
2	10496.03222660000	2	El Bosque	1
2	10184.01660160000	2	El Bosque	1
2	10397.36425780000	2	El Bosque	1
2	10364.84375000000	2	El Bosque	1
2	10051.06152340000	2	El Bosque	1
2	10416.73046880000	2	El Bosque	1
2	10349.35546880000	2	El Bosque	1
2	9801.11914063000	2	El Bosque	1
2	9648.62207031000	2	El Bosque	1
2	9460.39550781000	2	El Bosque	1
2	9486.57714844000	2	El Bosque	1
2	9286.27929688000	2	El Bosque	1
2	9136.56542969000	2	El Bosque	1
2	8833.84863281000	2	El Bosque	1
2	8669.57519531000	2	El Bosque	1
2	8558.80761719000	2	El Bosque	1
2	8444.99511719000	2	El Bosque	1
2	8515.39355469000	2	El Bosque	1
2	8347.70703125000	2	El Bosque	1
2	8370.87597656000	2	El Bosque	1
2	8189.93750000000	2	El Bosque	1
2	8859.70703125000	2	El Bosque	1
2	8474.75585938000	2	El Bosque	1
2	8397.84082031000	2	El Bosque	1
2	7897.70361328000	2	El Bosque	1
2	8002.68505859000	2	El Bosque	1
2	8048.39990234000	2	El Bosque	1
2	7942.94384766000	2	El Bosque	1
2	7736.55419922000	2	El Bosque	1
2	7233.48242188000	2	El Bosque	1
2	7613.51806641000	2	El Bosque	1
2	7481.14794922000	2	El Bosque	1
2	7512.99218750000	2	El Bosque	1
2	7587.44726563000	2	El Bosque	1
2	6960.73242188000	2	El Bosque	1
2	7358.94189453000	2	El Bosque	1
2	6874.94970703000	2	El Bosque	1
2	7329.57519531000	2	El Bosque	1
2	6916.51025391000	2	El Bosque	1
2	6819.25830078000	2	El Bosque	1
2	7077.48681641000	2	El Bosque	1
2	6892.46435547000	2	El Bosque	1
2	10031.22363280000	2	El Bosque	1
2	6439.18896484000	2	El Bosque	1
2	6550.62011719000	2	El Bosque	1
2	6339.41455078000	2	El Bosque	1
2	6501.64453125000	2	El Bosque	1
2	6837.81005859000	2	El Bosque	1
2	6340.20312500000	2	El Bosque	1

2	6582.91113281000	2	El Bosque	1
2	6225.69384766000	2	El Bosque	1
2	6186.76269531000	2	El Bosque	1
2	6527.98583984000	2	El Bosque	1
2	5960.89599609000	2	El Bosque	1
2	7370.27099609000	2	El Bosque	1
2	6188.10937500000	2	El Bosque	1
2	6293.04150391000	2	El Bosque	1
2	6889.36083984000	2	El Bosque	1
2	7153.76660156000	2	El Bosque	1
2	9278.22265625000	2	El Bosque	1
2	8126.04785156000	2	El Bosque	1
2	6095.02197266000	2	El Bosque	1
2	6039.30810547000	2	El Bosque	1
2	6100.11718750000	2	El Bosque	1
2	5784.81640625000	2	El Bosque	1
2	6018.91357422000	2	El Bosque	1
2	9727.72070313000	2	El Bosque	1
2	6047.55078125000	2	El Bosque	1
2	6087.19824219000	2	El Bosque	1
2	6493.82714844000	2	El Bosque	1
2	6012.07031250000	2	El Bosque	1
2	5867.19824219000	2	El Bosque	1
2	5932.52441406000	2	El Bosque	1
2	5936.09912109000	2	El Bosque	1
2	5818.24462891000	2	El Bosque	1
2	5509.24853516000	2	El Bosque	1
2	5644.53222656000	2	El Bosque	1
2	9442.00683594000	2	El Bosque	1
2	6895.60498047000	2	El Bosque	1
2	6733.87500000000	2	El Bosque	1
2	5696.72656250000	2	El Bosque	1
2	5585.44921875000	2	El Bosque	1
2	6398.96679688000	2	El Bosque	1
2	5440.32568359000	2	El Bosque	1
2	5739.50439453000	2	El Bosque	1
2	5510.67089844000	2	El Bosque	1
2	5425.31103516000	2	El Bosque	1
2	5388.76074219000	2	El Bosque	1
2	5631.90136719000	2	El Bosque	1
2	5358.36425781000	2	El Bosque	1
2	5187.85400391000	2	El Bosque	1
2	8394.83691406000	2	El Bosque	1
2	5199.68359375000	2	El Bosque	1
2	8521.27246094000	2	El Bosque	1
2	6119.40722656000	2	El Bosque	1
2	4855.43652344000	2	El Bosque	1
2	6423.01171875000	2	El Bosque	1
2	5125.52783203000	2	El Bosque	1
2	4657.11035156000	2	El Bosque	1
2	4888.61230469000	2	El Bosque	1

2	5056.71679688000	2	El Bosque	1
2	5094.78515625000	2	El Bosque	1
2	4846.75830078000	2	El Bosque	1
2	8592.56738281000	2	El Bosque	1
2	7698.54199219000	2	El Bosque	1
2	5565.79687500000	2	El Bosque	1
2	4766.15673828000	2	El Bosque	1
2	4723.33740234000	2	El Bosque	1
2	8657.23046875000	2	El Bosque	1
2	4623.64355469000	2	El Bosque	1
2	4398.82568359000	2	El Bosque	1
2	7094.37158203000	2	El Bosque	1
2	4315.75292969000	2	El Bosque	1
2	8562.94433594000	2	El Bosque	1
2	4384.38330078000	2	El Bosque	1
2	4384.93261719000	2	El Bosque	1
2	6565.78320313000	2	El Bosque	1
2	7309.62451172000	2	El Bosque	1
2	9120.97851563000	2	El Bosque	1
2	8052.26611328000	2	El Bosque	1
2	4270.86083984000	2	El Bosque	1
2	6801.53369141000	2	El Bosque	1
2	7470.65966797000	2	El Bosque	1
2	4259.21582031000	2	El Bosque	1
2	9167.35351563000	2	El Bosque	1
2	4083.24438477000	2	El Bosque	1
2	7202.12207031000	2	El Bosque	1
2	6974.48144531000	2	El Bosque	1
2	4108.94091797000	2	El Bosque	1
2	7551.22119141000	2	El Bosque	1
2	8156.12060547000	2	El Bosque	1
2	3951.13452148000	2	El Bosque	1
2	7698.68994141000	2	El Bosque	1
2	4251.43359375000	2	El Bosque	1
2	4200.37304688000	2	El Bosque	1
2	4046.65576172000	2	El Bosque	1
2	7375.44238281000	2	El Bosque	1
2	4112.73535156000	2	El Bosque	1
2	9234.52246094000	2	El Bosque	1
2	3583.57495117000	2	El Bosque	1
2	3632.33349609000	2	El Bosque	1
2	3429.64526367000	2	El Bosque	1
2	3849.32690430000	2	El Bosque	1
2	3534.62939453000	2	El Bosque	1
2	3814.84375000000	2	El Bosque	1
2	3512.63793945000	2	El Bosque	1
2	3610.01928711000	2	El Bosque	1
2	3565.08471680000	2	El Bosque	1
2	3810.15063477000	2	El Bosque	1
2	3731.98437500000	2	El Bosque	1
2	3700.29785156000	2	El Bosque	1

2	3420.69287109000	2	El Bosque	1
2	3448.41186523000	2	El Bosque	1
2	3299.97412109000	2	El Bosque	1
2	3709.01538086000	2	El Bosque	1
2	3594.99829102000	2	El Bosque	1
2	3196.39746094000	2	El Bosque	1
2	3314.12866211000	2	El Bosque	1
2	3130.50024414000	2	El Bosque	1
2	3316.33447266000	2	El Bosque	1
2	3352.87426758000	2	El Bosque	1
2	4449.38867188000	2	El Bosque	1
2	3582.07983398000	2	El Bosque	1
2	3028.41772461000	2	El Bosque	1
2	3169.97021484000	2	El Bosque	1
2	2994.34667969000	2	El Bosque	1
2	3059.57397461000	2	El Bosque	1
2	2977.67578125000	2	El Bosque	1
2	3016.55053711000	2	El Bosque	1
2	3375.12524414000	2	El Bosque	1
2	2764.35986328000	2	El Bosque	1
2	2932.16796875000	2	El Bosque	1
2	3529.42163086000	2	El Bosque	1
2	2911.14526367000	2	El Bosque	1
2	2870.39501953000	2	El Bosque	1
2	8056.61181641000	2	El Bosque	1
2	8086.56152344000	2	El Bosque	1
2	3163.30493164000	2	El Bosque	1
2	3007.29321289000	2	El Bosque	1
2	3309.45532227000	2	El Bosque	1
2	2930.90478516000	2	El Bosque	1
2	8965.42089844000	2	El Bosque	1
2	2989.70947266000	2	El Bosque	1
2	2848.41479492000	2	El Bosque	1
2	6876.71972656000	2	El Bosque	1
2	6384.21337891000	2	El Bosque	1
2	2901.30761719000	2	El Bosque	1
2	3358.78417969000	2	El Bosque	1
2	9613.66601563000	2	El Bosque	1
2	6674.95751953000	2	El Bosque	1
2	3377.51171875000	2	El Bosque	1
2	9257.00195313000	2	El Bosque	1
2	2785.14916992000	2	El Bosque	1
2	8602.28808594000	2	El Bosque	1
2	8853.56835938000	2	El Bosque	1
2	6055.85595703000	2	El Bosque	1
2	3482.91528320000	2	El Bosque	1
2	6218.78710938000	2	El Bosque	1
2	8296.13085938000	2	El Bosque	1
2	9120.65332031000	2	El Bosque	1
2	6285.55712891000	2	El Bosque	1
2	8270.63281250000	2	El Bosque	1

2	5836.34814453000	2	El Bosque	1
2	8317.20605469000	2	El Bosque	1
2	9512.29101563000	2	El Bosque	1
2	6193.39746094000	2	El Bosque	1
2	8622.14355469000	2	El Bosque	1
2	5472.68164063000	2	El Bosque	1
2	9386.08300781000	2	El Bosque	1
2	6298.04541016000	2	El Bosque	1
2	5969.68896484000	2	El Bosque	1
2	7542.43652344000	2	El Bosque	1
2	9670.50878906000	2	El Bosque	1
2	5225.96728516000	2	El Bosque	1
2	5527.13476563000	2	El Bosque	1
2	2733.02050781000	2	El Bosque	1
2	1674.86950684000	2	El Bosque	1
2	5707.64257813000	2	El Bosque	1
2	9723.26562500000	2	El Bosque	1
2	9336.20312500000	2	El Bosque	1
2	9321.30468750000	2	El Bosque	1
2	3830.51562500000	2	El Bosque	1
2	7542.07666016000	2	El Bosque	1
2	5030.98339844000	2	El Bosque	1
2	1363.79650879000	2	El Bosque	1
2	2556.29443359000	2	El Bosque	1
2	1682.16674805000	2	El Bosque	1
2	8645.27441406000	2	El Bosque	1
2	4090.00781250000	2	El Bosque	1
2	1212.01245117000	2	El Bosque	1
2	7552.34765625000	2	El Bosque	1
2	4464.93554688000	2	El Bosque	1
2	2507.10058594000	2	El Bosque	1
2	3593.84790039000	2	El Bosque	1
2	3866.91601563000	2	El Bosque	1
2	1180.60986328000	2	El Bosque	1
2	4295.21435547000	2	El Bosque	1
2	9767.82910156000	2	El Bosque	1
2	1438.28332520000	2	El Bosque	1
2	8972.01855469000	2	El Bosque	1
2	4202.27001953000	2	El Bosque	1
2	9966.11914063000	2	El Bosque	1
2	5146.99560547000	2	El Bosque	1
2	919.81304931600	2	El Bosque	1
2	4276.41845703000	2	El Bosque	1
2	8591.53027344000	2	El Bosque	1
2	1409.57885742000	2	El Bosque	1
2	4670.76074219000	2	El Bosque	1
2	8962.03613281000	2	El Bosque	1
2	9816.58105469000	2	El Bosque	1
2	826.57849121100	2	El Bosque	1
2	7453.25244141000	2	El Bosque	1
2	1197.70825195000	2	El Bosque	1

2	707.66314697300	2	El Bosque	1
2	4423.99218750000	2	El Bosque	1
2	6356.42480469000	2	El Bosque	1
2	5871.44775391000	2	El Bosque	1
2	732.23699951200	2	El Bosque	1
2	1307.00439453000	2	El Bosque	1
2	1091.03662109000	2	El Bosque	1
2	9684.34375000000	2	El Bosque	1
2	2467.48437500000	2	El Bosque	1
2	7205.99902344000	2	El Bosque	1
2	978.63818359400	2	El Bosque	1
2	4855.66455078000	2	El Bosque	1
2	1102.94165039000	2	El Bosque	1
2	562.79382324200	2	El Bosque	1
2	3523.82495117000	2	El Bosque	1
2	4512.01562500000	2	El Bosque	1
2	1338.32543945000	2	El Bosque	1
2	3795.34570313000	2	El Bosque	1
2	8678.30371094000	2	El Bosque	1
2	3666.15698242000	2	El Bosque	1
2	297.95236206100	2	El Bosque	1
2	5587.64794922000	2	El Bosque	1
2	904.78381347700	2	El Bosque	1
2	2340.54882813000	2	El Bosque	1
2	994.54241943400	2	El Bosque	1
2	3285.00341797000	2	El Bosque	1
2	2905.65136719000	2	El Bosque	1
2	199.09657287600	2	El Bosque	1
2	3645.82470703000	2	El Bosque	1
2	842.53472900400	2	El Bosque	1
2	2121.39990234000	2	El Bosque	1
2	942.61840820300	2	El Bosque	1
2	1889.83752441000	2	El Bosque	1
2	680.43060302700	2	El Bosque	1
2	5094.91943359000	2	El Bosque	1
2	10057.12792970000	2	El Bosque	1
2	1428.44824219000	2	El Bosque	1
2	738.31170654300	2	El Bosque	1
2	3705.23193359000	2	El Bosque	1
2	4143.43164063000	2	El Bosque	1
2	10129.03417970000	2	El Bosque	1
2	316.61999511700	2	El Bosque	1
2	1357.77722168000	2	El Bosque	1
2	279.61950683600	2	El Bosque	1
2	245.41096496600	2	El Bosque	1
2	592.87731933600	2	El Bosque	1
2	1437.89111328000	2	El Bosque	1
2	1659.03686523000	2	El Bosque	1
2	6537.73095703000	2	El Bosque	1
2	3711.00659180000	2	El Bosque	1
2	3029.29370117000	2	El Bosque	1

2	3805.12036133000	2	El Bosque	1
2	6776.69140625000	2	El Bosque	1
2	1804.88256836000	2	El Bosque	1
2	4366.06250000000	2	El Bosque	1
2	1633.61804199000	2	El Bosque	1
2	7187.95703125000	2	El Bosque	1
2	679.11242675800	2	El Bosque	1
2	8987.55078125000	2	El Bosque	1
2	1088.54296875000	2	El Bosque	1
2	8250.51074219000	2	El Bosque	1
2	1311.29614258000	2	El Bosque	1
2	2885.69750977000	2	El Bosque	1
2	3357.13818359000	2	El Bosque	1
2	10702.63671880000	2	El Bosque	1
2	10463.37695310000	2	El Bosque	1
2	3147.35327148000	2	El Bosque	1
2	2603.89135742000	2	El Bosque	1
2	8834.19238281000	2	El Bosque	1
2	7108.69531250000	2	El Bosque	1
2	6438.46533203000	2	El Bosque	1
2	7090.38574219000	2	El Bosque	1
2	10416.05566410000	2	El Bosque	1
2	6136.84570313000	2	El Bosque	1
2	7190.20654297000	2	El Bosque	1
2	5108.45263672000	2	El Bosque	1
2	6272.17480469000	2	El Bosque	1
2	3274.39721680000	2	El Bosque	1
2	3410.91235352000	2	El Bosque	1
2	2128.62792969000	2	El Bosque	1
2	2275.59594727000	2	El Bosque	1
2	10505.60742190000	2	El Bosque	1
2	6864.05566406000	2	El Bosque	1
2	3736.09594727000	2	El Bosque	1
2	2928.83911133000	2	El Bosque	1
2	7491.03710938000	2	El Bosque	1
2	5295.96923828000	2	El Bosque	1
2	8731.64550781000	2	El Bosque	1
2	5823.97802734000	2	El Bosque	1
2	2439.56372070000	2	El Bosque	1
2	6321.65869141000	2	El Bosque	1
2	3041.63623047000	2	El Bosque	1
2	8032.64404297000	2	El Bosque	1
2	12179.59667970000	2	El Bosque	1
2	2175.81054688000	2	El Bosque	1
2	10774.92773440000	2	El Bosque	1
2	7987.37646484000	2	El Bosque	1
2	12220.93847660000	2	El Bosque	1
2	11862.35156250000	2	El Bosque	1
2	11345.73925780000	2	El Bosque	1
2	6156.25634766000	2	El Bosque	1
2	8145.20654297000	2	El Bosque	1

2	3497.97656250000	2	El Bosque	1
2	3186.10131836000	2	El Bosque	1
2	8552.56640625000	2	El Bosque	1
2	8654.21875000000	2	El Bosque	1
2	11921.18554690000	2	El Bosque	1
2	8768.46875000000	2	El Bosque	1
2	9305.56933594000	2	El Bosque	1
2	8789.57812500000	2	El Bosque	1
2	8952.81347656000	2	El Bosque	1
2	9424.75292969000	2	El Bosque	1
2	9842.43457031000	2	El Bosque	1
2	9844.51367188000	2	El Bosque	1
2	9569.75488281000	2	El Bosque	1
2	9649.28613281000	2	El Bosque	1
2	9580.83984375000	2	El Bosque	1
2	10231.87890630000	2	El Bosque	1
2	10282.38769530000	2	El Bosque	1
2	10337.38281250000	2	El Bosque	1
2	10740.30761720000	2	El Bosque	1
2	10951.89453130000	2	El Bosque	1
2	11634.94335940000	2	El Bosque	1
2	12012.36718750000	2	El Bosque	1
2	11375.18261720000	2	El Bosque	1
2	12168.74902340000	2	El Bosque	1
2	11618.82421880000	2	El Bosque	1
2	12341.42285160000	2	El Bosque	1
2	12744.90039060000	2	El Bosque	1
2	12759.83691410000	2	El Bosque	1
2	13266.31835940000	2	El Bosque	1
2	13635.77929690000	2	El Bosque	1
2	14037.21777340000	2	El Bosque	1
2	13397.84472660000	2	El Bosque	1
2	12864.74218750000	2	El Bosque	1
2	14064.21679690000	2	El Bosque	1
2	13813.05664060000	2	El Bosque	1
2	13818.72070310000	2	El Bosque	1
2	12842.43164060000	2	El Bosque	1
2	15276.91796880000	2	El Bosque	1
2	13032.85937500000	2	El Bosque	2
2	12791.95019530000	2	El Bosque	2
2	12414.88281250000	2	El Bosque	2
2	12721.48046880000	2	El Bosque	2
2	10604.86328130000	2	El Bosque	2
2	10680.20996090000	2	El Bosque	2
2	10584.85644530000	2	El Bosque	2
2	10384.88769530000	2	El Bosque	2
2	10188.54003910000	2	El Bosque	2
2	9883.94140625000	2	El Bosque	2
2	10321.36230470000	2	El Bosque	2
2	9529.08105469000	2	El Bosque	2
2	9940.60644531000	2	El Bosque	2

2	8825.45800781000	2	El Bosque	2
2	8514.08300781000	2	El Bosque	2
2	8579.51953125000	2	El Bosque	2
2	7519.47070313000	2	El Bosque	2
2	7497.34667969000	2	El Bosque	2
2	7213.20898438000	2	El Bosque	2
2	6753.80322266000	2	El Bosque	2
2	6593.07177734000	2	El Bosque	2
2	6265.31591797000	2	El Bosque	2
2	6561.14746094000	2	El Bosque	2
2	6324.10205078000	2	El Bosque	2
2	6284.70458984000	2	El Bosque	2
2	6119.44677734000	2	El Bosque	2
2	5792.23828125000	2	El Bosque	2
2	6054.50390625000	2	El Bosque	2
2	5859.87792969000	2	El Bosque	2
2	5315.99902344000	2	El Bosque	2
2	5425.49511719000	2	El Bosque	2
2	6269.08203125000	2	El Bosque	2
2	5243.75976563000	2	El Bosque	2
2	5084.66259766000	2	El Bosque	2
2	5096.72802734000	2	El Bosque	2
2	4586.53027344000	2	El Bosque	2
2	9015.93945313000	2	El Bosque	2
2	4475.16992188000	2	El Bosque	2
2	4435.43164063000	2	El Bosque	2
2	4292.40087891000	2	El Bosque	2
2	7413.62646484000	2	El Bosque	2
2	4202.85986328000	2	El Bosque	2
2	4341.77539063000	2	El Bosque	2
2	3968.50439453000	2	El Bosque	2
2	4097.03466797000	2	El Bosque	2
2	3779.75756836000	2	El Bosque	2
2	3605.51782227000	2	El Bosque	2
2	3636.87646484000	2	El Bosque	2
2	3857.80859375000	2	El Bosque	2
2	3821.56787109000	2	El Bosque	2
2	3817.58105469000	2	El Bosque	2
2	3539.94775391000	2	El Bosque	2
2	4041.34033203000	2	El Bosque	2
2	3815.83862305000	2	El Bosque	2
2	3355.73974609000	2	El Bosque	2
2	3189.53833008000	2	El Bosque	2
2	3600.52075195000	2	El Bosque	2
2	8595.00195313000	2	El Bosque	2
2	3203.84033203000	2	El Bosque	2
2	3205.48437500000	2	El Bosque	2
2	3480.72460938000	2	El Bosque	2
2	3159.63305664000	2	El Bosque	2
2	7951.64404297000	2	El Bosque	2
2	3167.43676758000	2	El Bosque	2

2	3691.82470703000	2	El Bosque	2
2	3188.42260742000	2	El Bosque	2
2	2948.08569336000	2	El Bosque	2
2	3672.79150391000	2	El Bosque	2
2	9133.10742188000	2	El Bosque	2
2	2662.95385742000	2	El Bosque	2
2	2812.35351563000	2	El Bosque	2
2	2882.97045898000	2	El Bosque	2
2	6296.59814453000	2	El Bosque	2
2	3132.63110352000	2	El Bosque	2
2	8058.35937500000	2	El Bosque	2
2	2119.72314453000	2	El Bosque	2
2	1970.77954102000	2	El Bosque	2
2	2642.16064453000	2	El Bosque	2
2	8631.82812500000	2	El Bosque	2
2	1865.86633301000	2	El Bosque	2
2	2981.08520508000	2	El Bosque	2
2	1583.46667480000	2	El Bosque	2
2	1471.67443848000	2	El Bosque	2
2	3652.66918945000	2	El Bosque	2
2	6110.72216797000	2	El Bosque	2
2	1945.48059082000	2	El Bosque	2
2	1428.17590332000	2	El Bosque	2
2	1023.47808838000	2	El Bosque	2
2	869.10314941400	2	El Bosque	2
2	1924.46923828000	2	El Bosque	2
2	677.37310791000	2	El Bosque	2
2	1160.12878418000	2	El Bosque	2
2	788.82537841800	2	El Bosque	2
2	274.35562133800	2	El Bosque	2
2	3248.43896484000	2	El Bosque	2
2	877.02044677700	2	El Bosque	2
2	846.31945800800	2	El Bosque	2
2	551.44006347700	2	El Bosque	2
2	3345.56323242000	2	El Bosque	2
2	10710.32421880000	2	El Bosque	2
2	3431.93017578000	2	El Bosque	2
2	1615.80004883000	2	El Bosque	2
2	9661.00195313000	2	El Bosque	2
2	3575.43652344000	2	El Bosque	2
2	8387.42578125000	2	El Bosque	2
2	8370.81347656000	2	El Bosque	2
2	8564.22363281000	2	El Bosque	2
2	8709.00878906000	2	El Bosque	2
2	10233.56542970000	2	El Bosque	3
2	9529.93457031000	2	El Bosque	3
2	6896.41015625000	2	El Bosque	3
2	6626.80419922000	2	El Bosque	3
2	5193.97949219000	2	El Bosque	3
2	3914.08642578000	2	El Bosque	3
2	4365.26220703000	2	El Bosque	3

2	3922.75024414000	2	El Bosque	3
2	3912.53247070000	2	El Bosque	3
2	4003.88427734000	2	El Bosque	3
2	3555.43676758000	2	El Bosque	3
2	3709.13061523000	2	El Bosque	3
2	3383.37841797000	2	El Bosque	3
2	3071.94873047000	2	El Bosque	3
2	8402.53808594000	2	El Bosque	3
2	3193.17675781000	2	El Bosque	3
2	3541.13696289000	2	El Bosque	3
2	2151.27172852000	2	El Bosque	3
2	3411.08032227000	2	El Bosque	3
2	1958.03356934000	2	El Bosque	3
2	8771.82617188000	2	El Bosque	3
2	1027.55834961000	2	El Bosque	3
2	800.30926513700	2	El Bosque	3
2	7473.20800781000	2	El Bosque	3
2	9831.47851563000	2	El Bosque	3
2	4942.45605469000	2	El Bosque	4
2	4643.87060547000	2	El Bosque	4
2	4724.52880859000	2	El Bosque	4
2	3388.14135742000	2	El Bosque	4
2	3213.44335938000	2	El Bosque	4
2	3384.69506836000	2	El Bosque	4
2	3792.83398438000	2	El Bosque	4
2	2779.48754883000	2	El Bosque	4
2	2524.64501953000	2	El Bosque	4
2	2706.49145508000	2	El Bosque	4
2	4506.83300781000	2	El Bosque	4
2	2025.78710938000	2	El Bosque	4
2	1756.96179199000	2	El Bosque	4
2	1559.14282227000	2	El Bosque	4
2	622.73986816400	2	El Bosque	4

Source Site: Group 10L-13

Start Type	Pathcosts	Zone	Sian Otot	End Type
3	13189.45312500000	2	El Bosque	1
3	13196.00781250000	2	El Bosque	1
3	13024.26757810000	2	El Bosque	1
3	12902.40136720000	2	El Bosque	1
3	12534.26269530000	2	El Bosque	1
3	14114.17871090000	2	El Bosque	1
3	12099.93554690000	2	El Bosque	1
3	13882.81445310000	2	El Bosque	1
3	12426.42480470000	2	El Bosque	1
3	12383.93652340000	2	El Bosque	1
3	12266.16308590000	2	El Bosque	1

3	11901.68359380000	2	El Bosque	1
3	11862.57421880000	2	El Bosque	1
3	11860.13281250000	2	El Bosque	1
3	11742.10742190000	2	El Bosque	1
3	11606.37500000000	2	El Bosque	1
3	11573.58496090000	2	El Bosque	1
3	12313.75781250000	2	El Bosque	1
3	12472.88476560000	2	El Bosque	1
3	11331.31835940000	2	El Bosque	1
3	11155.61718750000	2	El Bosque	1
3	10835.45410160000	2	El Bosque	1
3	12260.92871090000	2	El Bosque	1
3	10697.67675780000	2	El Bosque	1
3	11396.20605470000	2	El Bosque	1
3	10825.87304690000	2	El Bosque	1
3	11041.18945310000	2	El Bosque	1
3	10580.57910160000	2	El Bosque	1
3	10590.88671880000	2	El Bosque	1
3	10609.46972660000	2	El Bosque	1
3	10455.81738280000	2	El Bosque	1
3	10497.46777340000	2	El Bosque	1
3	10239.69726560000	2	El Bosque	1
3	9983.19921875000	2	El Bosque	1
3	10927.50585940000	2	El Bosque	1
3	10266.82421880000	2	El Bosque	1
3	9934.18750000000	2	El Bosque	1
3	10196.51953130000	2	El Bosque	1
3	10125.69140630000	2	El Bosque	1
3	10008.57812500000	2	El Bosque	1
3	10040.11523440000	2	El Bosque	1
3	10170.85449220000	2	El Bosque	1
3	10070.76074220000	2	El Bosque	1
3	9945.88378906000	2	El Bosque	1
3	9863.48339844000	2	El Bosque	1
3	11696.85253910000	2	El Bosque	1
3	11906.10546880000	2	El Bosque	1
3	10333.70703130000	2	El Bosque	1
3	9994.12500000000	2	El Bosque	1
3	9682.10644531000	2	El Bosque	1
3	9895.45898438000	2	El Bosque	1
3	9862.93652344000	2	El Bosque	1
3	9549.15722656000	2	El Bosque	1
3	9914.82324219000	2	El Bosque	1
3	9847.44824219000	2	El Bosque	1
3	9299.20117188000	2	El Bosque	1
3	9146.71191406000	2	El Bosque	1

3	8958.49121094000	2	El Bosque	1
3	8984.66015625000	2	El Bosque	1
3	8784.36914063000	2	El Bosque	1
3	8634.65527344000	2	El Bosque	1
3	8331.93164063000	2	El Bosque	1
3	8167.65722656000	2	El Bosque	1
3	8056.89404297000	2	El Bosque	1
3	7943.08789063000	2	El Bosque	1
3	8013.47802734000	2	El Bosque	1
3	7845.79736328000	2	El Bosque	1
3	7868.96337891000	2	El Bosque	1
3	7688.02636719000	2	El Bosque	1
3	8357.79199219000	2	El Bosque	1
3	7972.84326172000	2	El Bosque	1
3	7895.93261719000	2	El Bosque	1
3	7395.79248047000	2	El Bosque	1
3	7500.77392578000	2	El Bosque	1
3	7546.48876953000	2	El Bosque	1
3	7441.03271484000	2	El Bosque	1
3	7769.61035156000	2	El Bosque	1
3	6731.57128906000	2	El Bosque	1
3	7646.57421875000	2	El Bosque	1
3	7259.13720703000	2	El Bosque	1
3	7011.07910156000	2	El Bosque	1
3	7146.09716797000	2	El Bosque	1
3	6458.82128906000	2	El Bosque	1
3	6857.02880859000	2	El Bosque	1
3	6373.03857422000	2	El Bosque	1
3	6888.22509766000	2	El Bosque	1
3	6414.59912109000	2	El Bosque	1
3	6317.34716797000	2	El Bosque	1
3	6575.57373047000	2	El Bosque	1
3	6451.11425781000	2	El Bosque	1
3	9529.31152344000	2	El Bosque	1
3	5937.27587891000	2	El Bosque	1
3	6109.27001953000	2	El Bosque	1
3	5837.50146484000	2	El Bosque	1
3	6060.29394531000	2	El Bosque	1
3	6335.89892578000	2	El Bosque	1
3	6373.25927734000	2	El Bosque	1
3	6141.56054688000	2	El Bosque	1
3	5723.78076172000	2	El Bosque	1
3	5684.84960938000	2	El Bosque	1
3	6086.63574219000	2	El Bosque	1
3	5458.98486328000	2	El Bosque	1
3	6868.35888672000	2	El Bosque	1

3	6221.16552734000	2	El Bosque	1
3	6326.09765625000	2	El Bosque	1
3	6387.44873047000	2	El Bosque	1
3	6651.85449219000	2	El Bosque	1
3	8776.30957031000	2	El Bosque	1
3	7624.13378906000	2	El Bosque	1
3	5653.67187500000	2	El Bosque	1
3	6072.36425781000	2	El Bosque	1
3	5598.20410156000	2	El Bosque	1
3	5282.90527344000	2	El Bosque	1
3	5577.56298828000	2	El Bosque	1
3	9225.80761719000	2	El Bosque	1
3	5545.63769531000	2	El Bosque	1
3	5645.84765625000	2	El Bosque	1
3	5991.91503906000	2	El Bosque	1
3	6045.12646484000	2	El Bosque	1
3	5900.25439453000	2	El Bosque	1
3	5491.17431641000	2	El Bosque	1
3	5969.15527344000	2	El Bosque	1
3	5316.33154297000	2	El Bosque	1
3	5007.33740234000	2	El Bosque	1
3	5142.61914063000	2	El Bosque	1
3	8940.09667969000	2	El Bosque	1
3	6393.69287109000	2	El Bosque	1
3	6231.96289063000	2	El Bosque	1
3	5255.37597656000	2	El Bosque	1
3	5618.50537109000	2	El Bosque	1
3	5897.05468750000	2	El Bosque	1
3	5473.38232422000	2	El Bosque	1
3	5298.15380859000	2	El Bosque	1
3	5008.75781250000	2	El Bosque	1
3	4923.39794922000	2	El Bosque	1
3	4947.41015625000	2	El Bosque	1
3	5190.55126953000	2	El Bosque	1
3	4856.45117188000	2	El Bosque	1
3	4685.94287109000	2	El Bosque	1
3	7892.92480469000	2	El Bosque	1
3	5242.90332031000	2	El Bosque	1
3	8019.35986328000	2	El Bosque	1
3	5617.49511719000	2	El Bosque	1
3	4353.52343750000	2	El Bosque	1
3	5921.09765625000	2	El Bosque	1
3	5168.74804688000	2	El Bosque	1
3	4155.19726563000	2	El Bosque	1
3	4447.26269531000	2	El Bosque	1
3	5099.93652344000	2	El Bosque	1

3	5063.21435547000	2	El Bosque	1
3	4405.41015625000	2	El Bosque	1
3	8090.65771484000	2	El Bosque	1
3	7743.33447266000	2	El Bosque	1
3	5063.88476563000	2	El Bosque	1
3	4324.80761719000	2	El Bosque	1
3	4221.42382813000	2	El Bosque	1
3	8155.31884766000	2	El Bosque	1
3	4230.78955078000	2	El Bosque	1
3	3896.91088867000	2	El Bosque	1
3	7139.16406250000	2	El Bosque	1
3	3874.40527344000	2	El Bosque	1
3	8775.52343750000	2	El Bosque	1
3	3882.46679688000	2	El Bosque	1
3	3943.58422852000	2	El Bosque	1
3	6063.86914063000	2	El Bosque	1
3	6807.71044922000	2	El Bosque	1
3	8562.33300781000	2	El Bosque	1
3	8161.84619141000	2	El Bosque	1
3	3882.27856445000	2	El Bosque	1
3	6846.32617188000	2	El Bosque	1
3	6968.74560547000	2	El Bosque	1
3	3757.30200195000	2	El Bosque	1
3	8561.81835938000	2	El Bosque	1
3	4112.44042969000	2	El Bosque	1
3	7246.91455078000	2	El Bosque	1
3	7019.27392578000	2	El Bosque	1
3	4152.16064453000	2	El Bosque	1
3	7596.01367188000	2	El Bosque	1
3	7654.20654297000	2	El Bosque	1
3	3977.29199219000	2	El Bosque	1
3	7894.88037109000	2	El Bosque	1
3	4296.22558594000	2	El Bosque	1
3	3759.02368164000	2	El Bosque	1
3	3544.74121094000	2	El Bosque	1
3	7456.79003906000	2	El Bosque	1
3	3610.82031250000	2	El Bosque	1
3	8498.11621094000	2	El Bosque	1
3	3626.79467773000	2	El Bosque	1
3	3190.98461914000	2	El Bosque	1
3	3458.84130859000	2	El Bosque	1
3	3894.11889648000	2	El Bosque	1
3	3401.12695313000	2	El Bosque	1
3	3312.92919922000	2	El Bosque	1
3	3071.28906250000	2	El Bosque	1
3	3168.67041016000	2	El Bosque	1

3	3295.13500977000	2	El Bosque	1
3	3854.94262695000	2	El Bosque	1
3	3775.20410156000	2	El Bosque	1
3	3198.38330078000	2	El Bosque	1
3	3463.91259766000	2	El Bosque	1
3	3261.13354492000	2	El Bosque	1
3	2858.62548828000	2	El Bosque	1
3	3207.10083008000	2	El Bosque	1
3	3153.64941406000	2	El Bosque	1
3	3239.61718750000	2	El Bosque	1
3	2872.77978516000	2	El Bosque	1
3	3173.71997070000	2	El Bosque	1
3	3361.12597656000	2	El Bosque	1
3	3397.66625977000	2	El Bosque	1
3	4846.56640625000	2	El Bosque	1
3	3080.16528320000	2	El Bosque	1
3	2587.06884766000	2	El Bosque	1
3	3214.76220703000	2	El Bosque	1
3	2552.99780273000	2	El Bosque	1
3	2618.22509766000	2	El Bosque	1
3	2797.00878906000	2	El Bosque	1
3	2575.20166016000	2	El Bosque	1
3	2873.21069336000	2	El Bosque	1
3	2793.55590820000	2	El Bosque	1
3	2976.95996094000	2	El Bosque	1
3	3027.50708008000	2	El Bosque	1
3	2955.93725586000	2	El Bosque	1
3	2773.10400391000	2	El Bosque	1
3	8451.26953125000	2	El Bosque	1
3	7345.36621094000	2	El Bosque	1
3	3208.09692383000	2	El Bosque	1
3	2661.13989258000	2	El Bosque	1
3	3354.24731445000	2	El Bosque	1
3	2500.00683594000	2	El Bosque	1
3	9360.07617188000	2	El Bosque	1
3	3034.50146484000	2	El Bosque	1
3	2362.31616211000	2	El Bosque	1
3	6140.30908203000	2	El Bosque	1
3	6778.87255859000	2	El Bosque	1
3	2946.09960938000	2	El Bosque	1
3	3403.57617188000	2	El Bosque	1
3	10008.32031250000	2	El Bosque	1
3	5938.54687500000	2	El Bosque	1
3	3422.30371094000	2	El Bosque	1
3	9651.65625000000	2	El Bosque	1
3	2886.67700195000	2	El Bosque	1

3	8996.94238281000	2	El Bosque	1
3	9248.22265625000	2	El Bosque	1
3	6450.51464844000	2	El Bosque	1
3	3916.18139648000	2	El Bosque	1
3	5482.37646484000	2	El Bosque	1
3	8690.79199219000	2	El Bosque	1
3	8308.88183594000	2	El Bosque	1
3	5543.66845703000	2	El Bosque	1
3	8665.29394531000	2	El Bosque	1
3	5017.88671875000	2	El Bosque	1
3	8711.86816406000	2	El Bosque	1
3	9906.95312500000	2	El Bosque	1
3	6588.05615234000	2	El Bosque	1
3	9016.80371094000	2	El Bosque	1
3	5867.34033203000	2	El Bosque	1
3	8574.31542969000	2	El Bosque	1
3	5460.74755859000	2	El Bosque	1
3	5132.39111328000	2	El Bosque	1
3	6730.66699219000	2	El Bosque	1
3	10065.17089840000	2	El Bosque	1
3	4388.66845703000	2	El Bosque	1
3	4689.83593750000	2	El Bosque	1
3	3166.28662109000	2	El Bosque	1
3	1882.39904785000	2	El Bosque	1
3	4870.34472656000	2	El Bosque	1
3	10117.92089840000	2	El Bosque	1
3	8524.43945313000	2	El Bosque	1
3	9715.95996094000	2	El Bosque	1
3	3005.56884766000	2	El Bosque	1
3	6730.30712891000	2	El Bosque	1
3	5425.64208984000	2	El Bosque	1
3	1509.04724121000	2	El Bosque	1
3	2989.56054688000	2	El Bosque	1
3	2092.87988281000	2	El Bosque	1
3	9039.93164063000	2	El Bosque	1
3	3252.71264648000	2	El Bosque	1
3	1291.74060059000	2	El Bosque	1
3	6740.57812500000	2	El Bosque	1
3	4859.59570313000	2	El Bosque	1
3	2940.36669922000	2	El Bosque	1
3	2756.55273438000	2	El Bosque	1
3	3029.62109375000	2	El Bosque	1
3	1454.27355957000	2	El Bosque	1
3	4689.87548828000	2	El Bosque	1
3	10162.48437500000	2	El Bosque	1
3	1858.97460938000	2	El Bosque	1

3	8160.25146484000	2	El Bosque	1
3	3364.97509766000	2	El Bosque	1
3	10360.77441410000	2	El Bosque	1
3	4330.90039063000	2	El Bosque	1
3	1050.78002930000	2	El Bosque	1
3	4671.08251953000	2	El Bosque	1
3	8986.18554688000	2	El Bosque	1
3	1841.29431152000	2	El Bosque	1
3	3833.46948242000	2	El Bosque	1
3	9356.69140625000	2	El Bosque	1
3	10211.23632810000	2	El Bosque	1
3	924.51416015600	2	El Bosque	1
3	6641.48291016000	2	El Bosque	1
3	1620.16308594000	2	El Bosque	1
3	968.75915527300	2	El Bosque	1
3	4818.65087891000	2	El Bosque	1
3	5544.65527344000	2	El Bosque	1
3	5059.67822266000	2	El Bosque	1
3	1142.95019531000	2	El Bosque	1
3	1752.29443359000	2	El Bosque	1
3	898.98333740200	2	El Bosque	1
3	10078.99902340000	2	El Bosque	1
3	2862.14599609000	2	El Bosque	1
3	6394.22949219000	2	El Bosque	1
3	1423.92773438000	2	El Bosque	1
3	4043.89770508000	2	El Bosque	1
3	1548.23095703000	2	El Bosque	1
3	730.41333007800	2	El Bosque	1
3	2674.34179688000	2	El Bosque	1
3	3700.24707031000	2	El Bosque	1
3	737.42919921900	2	El Bosque	1
3	2945.04980469000	2	El Bosque	1
3	7866.53369141000	2	El Bosque	1
3	2815.86108398000	2	El Bosque	1
3	664.96569824200	2	El Bosque	1
3	4775.87841797000	2	El Bosque	1
3	1350.07421875000	2	El Bosque	1
3	2735.21166992000	2	El Bosque	1
3	1439.83312988000	2	El Bosque	1
3	2428.25341797000	2	El Bosque	1
3	2048.89892578000	2	El Bosque	1
3	527.04742431600	2	El Bosque	1
3	2827.06079102000	2	El Bosque	1
3	1287.82458496000	2	El Bosque	1
3	2516.06274414000	2	El Bosque	1
3	1342.46813965000	2	El Bosque	1

3	2284.50073242000	2	El Bosque	1
3	1103.06506348000	2	El Bosque	1
3	4283.15136719000	2	El Bosque	1
3	10451.78613280000	2	El Bosque	1
3	1823.11132813000	2	El Bosque	1
3	1121.08801270000	2	El Bosque	1
3	2908.27978516000	2	El Bosque	1
3	3346.47949219000	2	El Bosque	1
3	10523.69238280000	2	El Bosque	1
3	327.46362304700	2	El Bosque	1
3	1752.44018555000	2	El Bosque	1
3	643.70611572300	2	El Bosque	1
3	525.84637451200	2	El Bosque	1
3	180.53317260700	2	El Bosque	1
3	1832.55419922000	2	El Bosque	1
3	2053.69995117000	2	El Bosque	1
3	5725.96191406000	2	El Bosque	1
3	2914.05444336000	2	El Bosque	1
3	2232.34252930000	2	El Bosque	1
3	3008.16821289000	2	El Bosque	1
3	5964.92236328000	2	El Bosque	1
3	2199.54589844000	2	El Bosque	1
3	3569.11010742000	2	El Bosque	1
3	2010.73291016000	2	El Bosque	1
3	6376.18798828000	2	El Bosque	1
3	936.30584716800	2	El Bosque	1
3	8187.43701172000	2	El Bosque	1
3	1327.24780273000	2	El Bosque	1
3	7444.23046875000	2	El Bosque	1
3	1603.52807617000	2	El Bosque	1
3	2088.74536133000	2	El Bosque	1
3	2560.18603516000	2	El Bosque	1
3	11097.29492190000	2	El Bosque	1
3	10858.03515630000	2	El Bosque	1
3	2350.40161133000	2	El Bosque	1
3	1806.94006348000	2	El Bosque	1
3	8037.23339844000	2	El Bosque	1
3	7503.35351563000	2	El Bosque	1
3	6833.12695313000	2	El Bosque	1
3	7485.04394531000	2	El Bosque	1
3	10810.71386720000	2	El Bosque	1
3	6531.50732422000	2	El Bosque	1
3	7584.86474609000	2	El Bosque	1
3	5503.11328125000	2	El Bosque	1
3	6666.83642578000	2	El Bosque	1
3	3470.42309570000	2	El Bosque	1

3	3606.93823242000	2	El Bosque	1
3	2324.65356445000	2	El Bosque	1
3	2471.62231445000	2	El Bosque	1
3	10900.26562500000	2	El Bosque	1
3	7258.71728516000	2	El Bosque	1
3	3932.12207031000	2	El Bosque	1
3	3124.86499023000	2	El Bosque	1
3	7885.69531250000	2	El Bosque	1
3	5690.62988281000	2	El Bosque	1
3	9126.30371094000	2	El Bosque	1
3	6218.63867188000	2	El Bosque	1
3	7179.71923828000	2	El Bosque	1
3	2522.89721680000	2	El Bosque	1
3	6716.31933594000	2	El Bosque	1
3	3237.66210938000	2	El Bosque	1
3	7235.68554688000	2	El Bosque	1
3	12574.25488280000	2	El Bosque	1
3	1671.95117188000	2	El Bosque	1
3	11169.58593750000	2	El Bosque	1
3	7190.41796875000	2	El Bosque	1
3	12615.59667970000	2	El Bosque	1
3	12257.00976560000	2	El Bosque	1
3	11740.39746090000	2	El Bosque	1
3	6482.21533203000	2	El Bosque	1
3	8539.86718750000	2	El Bosque	1
3	2820.60375977000	2	El Bosque	1
3	2548.35595703000	2	El Bosque	1
3	8851.76757813000	2	El Bosque	1
3	8953.41992188000	2	El Bosque	1
3	12315.83593750000	2	El Bosque	1
3	9067.66992188000	2	El Bosque	1
3	9700.22558594000	2	El Bosque	1
3	9088.77929688000	2	El Bosque	1
3	9252.01464844000	2	El Bosque	1
3	9723.95410156000	2	El Bosque	1
3	10237.08300780000	2	El Bosque	1
3	10143.71484380000	2	El Bosque	1
3	9868.95605469000	2	El Bosque	1
3	9947.41406250000	2	El Bosque	1
3	9866.69433594000	2	El Bosque	1
3	10562.25683590000	2	El Bosque	1
3	10581.58886720000	2	El Bosque	1
3	10567.12207030000	2	El Bosque	1
3	11039.85644530000	2	El Bosque	1
3	11346.54296880000	2	El Bosque	1
3	12029.59375000000	2	El Bosque	1

3	12407.01757810000	2	El Bosque	1
3	11655.78125000000	2	El Bosque	1
3	12563.40136720000	2	El Bosque	1
3	11899.42285160000	2	El Bosque	1
3	12711.81445310000	2	El Bosque	1
3	13139.55273440000	2	El Bosque	1
3	13130.22851560000	2	El Bosque	1
3	13660.96875000000	2	El Bosque	1
3	14030.42968750000	2	El Bosque	1
3	14431.86816410000	2	El Bosque	1
3	13792.49511720000	2	El Bosque	1
3	13124.28808590000	2	El Bosque	1
3	14458.86718750000	2	El Bosque	1
3	14207.70703130000	2	El Bosque	1
3	14213.37109380000	2	El Bosque	1
3	13069.82812500000	2	El Bosque	1
3	15671.56835940000	2	El Bosque	1
3	12530.95312500000	2	El Bosque	2
3	12290.04003910000	2	El Bosque	2
3	11912.97265630000	2	El Bosque	2
3	12226.67773440000	2	El Bosque	2
3	10102.95312500000	2	El Bosque	2
3	10178.30273440000	2	El Bosque	2
3	10082.95117190000	2	El Bosque	2
3	9882.98046875000	2	El Bosque	2
3	9686.63476563000	2	El Bosque	2
3	9382.02343750000	2	El Bosque	2
3	9819.45703125000	2	El Bosque	2
3	9027.17675781000	2	El Bosque	2
3	9438.69921875000	2	El Bosque	2
3	8323.54296875000	2	El Bosque	2
3	8012.17089844000	2	El Bosque	2
3	8077.60839844000	2	El Bosque	2
3	7545.67822266000	2	El Bosque	2
3	6995.43359375000	2	El Bosque	2
3	6711.29589844000	2	El Bosque	2
3	6251.89013672000	2	El Bosque	2
3	6626.12792969000	2	El Bosque	2
3	6298.37207031000	2	El Bosque	2
3	6119.79687500000	2	El Bosque	2
3	5882.75195313000	2	El Bosque	2
3	5843.35400391000	2	El Bosque	2
3	5678.09619141000	2	El Bosque	2
3	5290.32519531000	2	El Bosque	2
3	5613.15332031000	2	El Bosque	2
3	5418.52832031000	2	El Bosque	2

3	5349.05517578000	2	El Bosque	2
3	5066.90527344000	2	El Bosque	2
3	5767.16992188000	2	El Bosque	2
3	4741.84667969000	2	El Bosque	2
3	4681.44580078000	2	El Bosque	2
3	5129.78417969000	2	El Bosque	2
3	4145.18212891000	2	El Bosque	2
3	8514.02734375000	2	El Bosque	2
3	4051.19848633000	2	El Bosque	2
3	3933.51757813000	2	El Bosque	2
3	4199.18945313000	2	El Bosque	2
3	7458.41894531000	2	El Bosque	2
3	3700.94531250000	2	El Bosque	2
3	4386.56689453000	2	El Bosque	2
3	3466.58984375000	2	El Bosque	2
3	4141.82666016000	2	El Bosque	2
3	3822.97729492000	2	El Bosque	2
3	3634.71386719000	2	El Bosque	2
3	3666.07250977000	2	El Bosque	2
3	3902.60058594000	2	El Bosque	2
3	3319.65332031000	2	El Bosque	2
3	3376.23217773000	2	El Bosque	2
3	3583.16748047000	2	El Bosque	2
3	4086.13232422000	2	El Bosque	2
3	3313.92407227000	2	El Bosque	2
3	3384.93579102000	2	El Bosque	2
3	3218.73437500000	2	El Bosque	2
3	3098.60620117000	2	El Bosque	2
3	7858.58984375000	2	El Bosque	2
3	2762.49145508000	2	El Bosque	2
3	3250.27539063000	2	El Bosque	2
3	2978.81005859000	2	El Bosque	2
3	3204.42456055000	2	El Bosque	2
3	7215.23339844000	2	El Bosque	2
3	3212.22875977000	2	El Bosque	2
3	3189.91015625000	2	El Bosque	2
3	3233.21459961000	2	El Bosque	2
3	2992.87768555000	2	El Bosque	2
3	3144.18090820000	2	El Bosque	2
3	9527.76562500000	2	El Bosque	2
3	2707.74584961000	2	El Bosque	2
3	2371.13012695000	2	El Bosque	2
3	2927.76245117000	2	El Bosque	2
3	6691.25683594000	2	El Bosque	2
3	2464.54663086000	2	El Bosque	2
3	8453.01367188000	2	El Bosque	2

3	2164.51464844000	2	El Bosque	2
3	2015.57141113000	2	El Bosque	2
3	3054.58276367000	2	El Bosque	2
3	7820.05468750000	2	El Bosque	2
3	2083.78198242000	2	El Bosque	2
3	3414.35131836000	2	El Bosque	2
3	1555.28637695000	2	El Bosque	2
3	1477.60229492000	2	El Bosque	2
3	2827.72216797000	2	El Bosque	2
3	5273.42431641000	2	El Bosque	2
3	2384.25659180000	2	El Bosque	2
3	1370.33044434000	2	El Bosque	2
3	1016.73364258000	2	El Bosque	2
3	818.12011718800	2	El Bosque	2
3	2339.62182617000	2	El Bosque	2
3	733.57232666000	2	El Bosque	2
3	758.35394287100	2	El Bosque	2
3	529.57293701200	2	El Bosque	2
3	702.38641357400	2	El Bosque	2
3	2391.68627930000	2	El Bosque	2
3	353.51501464800	2	El Bosque	2
3	517.42169189500	2	El Bosque	2
3	1217.20800781000	2	El Bosque	2
3	934.21685791000	2	El Bosque	2
3	377.58740234400	2	El Bosque	2
3	2548.61157227000	2	El Bosque	2
3	11104.98242190000	2	El Bosque	2
3	2634.97729492000	2	El Bosque	2
3	1502.43725586000	2	El Bosque	2
3	10055.65917970000	2	El Bosque	2
3	2898.06420898000	2	El Bosque	2
3	8782.08691406000	2	El Bosque	2
3	8765.46972656000	2	El Bosque	2
3	8958.87597656000	2	El Bosque	2
3	9008.20996094000	2	El Bosque	2
3	9731.66308594000	2	El Bosque	3
3	9028.02441406000	2	El Bosque	3
3	6394.49707031000	2	El Bosque	3
3	6185.45361328000	2	El Bosque	3
3	4752.62988281000	2	El Bosque	3
3	3472.73779297000	2	El Bosque	3
3	3887.84716797000	2	El Bosque	3
3	3965.96997070000	2	El Bosque	3
3	3410.61791992000	2	El Bosque	3
3	3501.96972656000	2	El Bosque	3
3	3053.52221680000	2	El Bosque	3

3	3207.21606445000	2	El Bosque	3
3	2881.46386719000	2	El Bosque	3
3	2909.86572266000	2	El Bosque	3
3	8797.20410156000	2	El Bosque	3
3	2691.26220703000	2	El Bosque	3
3	3585.92895508000	2	El Bosque	3
3	2180.46777344000	2	El Bosque	3
3	3465.21704102000	2	El Bosque	3
3	1929.85327148000	2	El Bosque	3
3	9166.48339844000	2	El Bosque	3
3	161.44659423800	2	El Bosque	3
3	81.35955810550	2	El Bosque	3
3	7867.86621094000	2	El Bosque	3
3	10130.67968750000	2	El Bosque	3
3	4501.10400391000	2	El Bosque	4
3	4141.95605469000	2	El Bosque	4
3	4769.32226563000	2	El Bosque	4
3	3417.33740234000	2	El Bosque	4
3	3258.23535156000	2	El Bosque	4
3	2882.78051758000	2	El Bosque	4
3	3263.74902344000	2	El Bosque	4
3	2291.34204102000	2	El Bosque	4
3	9273.59765625000	2	El Bosque	4
3	2756.49902344000	2	El Bosque	4
3	2092.86596680000	2	El Bosque	4
3	4940.09960938000	2	El Bosque	4
3	2216.10180664000	2	El Bosque	4
3	1801.75366211000	2	El Bosque	4
3	1629.52966309000	2	El Bosque	4
3	1051.66564941000	2	El Bosque	4

Source Site: Group 10J-6

Start Type	Pathcost	Zone	Sian Otot	End Type
3	13360.96777340000	3	Comedero	1
3	13472.48925780000	3	Comedero	1
3	13235.13964840000	3	Comedero	1
3	13182.05078130000	3	Comedero	1
3	12813.91210940000	3	Comedero	1
3	14393.83007810000	3	Comedero	1
3	12241.46191410000	3	Comedero	1
3	14162.46582030000	3	Comedero	1
3	12706.07617190000	3	Comedero	1
3	11738.11425780000	3	Comedero	1
3	12545.81250000000	3	Comedero	1
3	12181.33691410000	3	Comedero	1
3	12142.22363280000	3	Comedero	1

3	12139.78222660000	3	Comedero	1
3	12021.76074220000	3	Comedero	1
3	11886.02832030000	3	Comedero	1
3	11853.23828130000	3	Comedero	1
3	12593.40917970000	3	Comedero	1
3	12752.53613280000	3	Comedero	1
3	11610.96875000000	3	Comedero	1
3	11435.26660160000	3	Comedero	1
3	10755.39843750000	3	Comedero	1
3	12540.57910160000	3	Comedero	1
3	10936.52441410000	3	Comedero	1
3	11675.85742190000	3	Comedero	1
3	11105.52148440000	3	Comedero	1
3	11320.83984380000	3	Comedero	1
3	10860.23144530000	3	Comedero	1
3	10870.53906250000	3	Comedero	1
3	10889.11816410000	3	Comedero	1
3	10735.46972660000	3	Comedero	1
3	10777.11621090000	3	Comedero	1
3	10519.35058590000	3	Comedero	1
3	10262.84960940000	3	Comedero	1
3	11207.15722660000	3	Comedero	1
3	10546.47265630000	3	Comedero	1
3	10213.84082030000	3	Comedero	1
3	10476.17089840000	3	Comedero	1
3	10405.34082030000	3	Comedero	1
3	10288.22753910000	3	Comedero	1
3	10319.76367190000	3	Comedero	1
3	10450.50585940000	3	Comedero	1
3	10350.40917970000	3	Comedero	1
3	10225.53320310000	3	Comedero	1
3	10143.13281250000	3	Comedero	1
3	11976.50097660000	3	Comedero	1
3	12185.75390630000	3	Comedero	1
3	9862.98144531000	3	Comedero	1
3	10273.77636720000	3	Comedero	1
3	9961.75683594000	3	Comedero	1
3	10175.10839840000	3	Comedero	1
3	10142.58789060000	3	Comedero	1
3	9828.80468750000	3	Comedero	1
3	10194.47460940000	3	Comedero	1
3	10127.09960940000	3	Comedero	1
3	9578.85449219000	3	Comedero	1
3	9426.36230469000	3	Comedero	1
3	9238.13867188000	3	Comedero	1
3	9264.31250000000	3	Comedero	1
3	9064.02148438000	3	Comedero	1
3	8914.30566406000	3	Comedero	1
3	8611.58398438000	3	Comedero	1
3	8447.31054688000	3	Comedero	1
3	8336.54296875000	3	Comedero	1

3	8222.73730469000	3	Comedero	1
3	8293.12792969000	3	Comedero	1
3	8125.44677734000	3	Comedero	1
3	8148.61279297000	3	Comedero	1
3	7967.67578125000	3	Comedero	1
3	8637.44335938000	3	Comedero	1
3	8252.49316406000	3	Comedero	1
3	8175.58398438000	3	Comedero	1
3	7675.44189453000	3	Comedero	1
3	7780.42333984000	3	Comedero	1
3	7826.13818359000	3	Comedero	1
3	7720.68212891000	3	Comedero	1
3	6562.33398438000	3	Comedero	1
3	7011.22070313000	3	Comedero	1
3	6417.78320313000	3	Comedero	1
3	6417.00195313000	3	Comedero	1
3	7290.73046875000	3	Comedero	1
3	7365.18310547000	3	Comedero	1
3	6738.47070313000	3	Comedero	1
3	7136.68017578000	3	Comedero	1
3	6652.68798828000	3	Comedero	1
3	7107.31103516000	3	Comedero	1
3	6694.24853516000	3	Comedero	1
3	6596.99658203000	3	Comedero	1
3	6855.22509766000	3	Comedero	1
3	6670.20019531000	3	Comedero	1
3	9808.96386719000	3	Comedero	1
3	6216.92724609000	3	Comedero	1
3	6328.35595703000	3	Comedero	1
3	6117.15283203000	3	Comedero	1
3	5933.79541016000	3	Comedero	1
3	6615.54833984000	3	Comedero	1
3	5140.88476563000	3	Comedero	1
3	6088.44970703000	3	Comedero	1
3	6003.43212891000	3	Comedero	1
3	5964.50097656000	3	Comedero	1
3	6305.72167969000	3	Comedero	1
3	5738.63427734000	3	Comedero	1
3	7148.00927734000	3	Comedero	1
3	4988.79101563000	3	Comedero	1
3	4709.43066406000	3	Comedero	1
3	6667.09912109000	3	Comedero	1
3	6931.50488281000	3	Comedero	1
3	9055.96191406000	3	Comedero	1
3	7903.78466797000	3	Comedero	1
3	5872.75781250000	3	Comedero	1
3	4865.70800781000	3	Comedero	1
3	5877.85546875000	3	Comedero	1
3	5562.55468750000	3	Comedero	1
3	5589.30566406000	3	Comedero	1
3	9505.45996094000	3	Comedero	1

3	5825.28906250000	3	Comedero	1
3	5864.93408203000	3	Comedero	1
3	6271.56542969000	3	Comedero	1
3	4550.54248047000	3	Comedero	1
3	4605.15966797000	3	Comedero	1
3	5710.26025391000	3	Comedero	1
3	4757.54003906000	3	Comedero	1
3	5595.98291016000	3	Comedero	1
3	5286.98681641000	3	Comedero	1
3	5422.27050781000	3	Comedero	1
3	9219.74609375000	3	Comedero	1
3	6673.34326172000	3	Comedero	1
3	6511.61328125000	3	Comedero	1
3	5474.46240234000	3	Comedero	1
3	4296.58593750000	3	Comedero	1
3	6176.70507813000	3	Comedero	1
3	4332.44189453000	3	Comedero	1
3	5070.67529297000	3	Comedero	1
3	5288.40917969000	3	Comedero	1
3	5203.04931641000	3	Comedero	1
3	5166.49658203000	3	Comedero	1
3	5409.63720703000	3	Comedero	1
3	5136.10253906000	3	Comedero	1
3	4965.59228516000	3	Comedero	1
3	8172.57617188000	3	Comedero	1
3	3524.72290039000	3	Comedero	1
3	8299.01074219000	3	Comedero	1
3	5897.14550781000	3	Comedero	1
3	4633.17480469000	3	Comedero	1
3	6200.74853516000	3	Comedero	1
3	3278.62353516000	3	Comedero	1
3	4434.84863281000	3	Comedero	1
3	4616.48437500000	3	Comedero	1
3	3685.59423828000	3	Comedero	1
3	4132.21044922000	3	Comedero	1
3	4624.49560547000	3	Comedero	1
3	8370.30859375000	3	Comedero	1
3	4518.85351563000	3	Comedero	1
3	5343.53515625000	3	Comedero	1
3	4474.24316406000	3	Comedero	1
3	4501.07373047000	3	Comedero	1
3	8434.97167969000	3	Comedero	1
3	4200.42236328000	3	Comedero	1
3	4176.56103516000	3	Comedero	1
3	3914.68457031000	3	Comedero	1
3	4066.63500977000	3	Comedero	1
3	5525.82958984000	3	Comedero	1
3	4162.11865234000	3	Comedero	1
3	4162.66845703000	3	Comedero	1
3	6343.52001953000	3	Comedero	1
3	7087.36132813000	3	Comedero	1

3	8898.71582031000	3	Comedero	1
3	4937.36474609000	3	Comedero	1
3	3890.09472656000	3	Comedero	1
3	3621.84692383000	3	Comedero	1
3	7248.39648438000	3	Comedero	1
3	4036.95288086000	3	Comedero	1
3	8945.09082031000	3	Comedero	1
3	3397.87426758000	3	Comedero	1
3	4022.43310547000	3	Comedero	1
3	3794.78979492000	3	Comedero	1
3	3270.69604492000	3	Comedero	1
3	4371.53076172000	3	Comedero	1
3	7933.85791016000	3	Comedero	1
3	3337.42163086000	3	Comedero	1
3	4661.57617188000	3	Comedero	1
3	1911.75585938000	3	Comedero	1
3	3978.10888672000	3	Comedero	1
3	3824.39208984000	3	Comedero	1
3	4225.74023438000	3	Comedero	1
3	3890.47119141000	3	Comedero	1
3	9049.19335938000	3	Comedero	1
3	2794.13574219000	3	Comedero	1
3	3410.06982422000	3	Comedero	1
3	2816.06958008000	3	Comedero	1
3	1561.54443359000	3	Comedero	1
3	3116.91210938000	3	Comedero	1
3	3592.58007813000	3	Comedero	1
3	3290.37426758000	3	Comedero	1
3	3387.75561523000	3	Comedero	1
3	3214.58959961000	3	Comedero	1
3	1837.70996094000	3	Comedero	1
3	2409.74462891000	3	Comedero	1
3	3478.03417969000	3	Comedero	1
3	2265.33935547000	3	Comedero	1
3	3097.91674805000	3	Comedero	1
3	3077.71044922000	3	Comedero	1
3	3486.75170898000	3	Comedero	1
3	3372.73461914000	3	Comedero	1
3	2418.97290039000	3	Comedero	1
3	3091.86499023000	3	Comedero	1
3	2252.97558594000	3	Comedero	1
3	1965.45996094000	3	Comedero	1
3	1878.86462402000	3	Comedero	1
3	1249.60571289000	3	Comedero	1
3	3359.81616211000	3	Comedero	1
3	2806.15405273000	3	Comedero	1
3	878.76281738300	3	Comedero	1
3	2772.08300781000	3	Comedero	1
3	2837.31030273000	3	Comedero	1
3	2627.18066406000	3	Comedero	1
3	2794.28686523000	3	Comedero	1

3	3152.86157227000	3	Comedero	1
3	2413.86474609000	3	Comedero	1
3	1055.70776367000	3	Comedero	1
3	3307.15795898000	3	Comedero	1
3	1337.35595703000	3	Comedero	1
3	2519.89990234000	3	Comedero	1
3	6106.25488281000	3	Comedero	1
3	7929.67480469000	3	Comedero	1
3	581.70495605500	3	Comedero	1
3	2656.79809570000	3	Comedero	1
3	459.01214599600	3	Comedero	1
3	2708.64111328000	3	Comedero	1
3	7015.06201172000	3	Comedero	1
3	621.66027832000	3	Comedero	1
3	2626.15112305000	3	Comedero	1
3	6719.83251953000	3	Comedero	1
3	3938.50463867000	3	Comedero	1
3	700.66149902300	3	Comedero	1
3	273.35418701200	3	Comedero	1
3	7663.30468750000	3	Comedero	1
3	6518.07031250000	3	Comedero	1
3	182.89250183100	3	Comedero	1
3	7306.64355469000	3	Comedero	1
3	749.08666992200	3	Comedero	1
3	6651.92919922000	3	Comedero	1
3	6903.20263672000	3	Comedero	1
3	3784.58886719000	3	Comedero	1
3	427.32339477500	3	Comedero	1
3	6061.89990234000	3	Comedero	1
3	6349.18505859000	3	Comedero	1
3	9142.18066406000	3	Comedero	1
3	6128.66992188000	3	Comedero	1
3	6323.68798828000	3	Comedero	1
3	5679.46093750000	3	Comedero	1
3	6370.25585938000	3	Comedero	1
3	7565.33789063000	3	Comedero	1
3	4238.28613281000	3	Comedero	1
3	6675.20263672000	3	Comedero	1
3	3281.39038086000	3	Comedero	1
3	9588.34082031000	3	Comedero	1
3	6314.47998047000	3	Comedero	1
3	5939.10253906000	3	Comedero	1
3	7699.69580078000	3	Comedero	1
3	7723.55419922000	3	Comedero	1
3	5239.93994141000	3	Comedero	1
3	5557.32861328000	3	Comedero	1
3	554.88629150400	3	Comedero	1
3	1699.44396973000	3	Comedero	1
3	5819.48925781000	3	Comedero	1
3	7784.46728516000	3	Comedero	1
3	9636.92089844000	3	Comedero	1

3	7382.50878906000	3	Comedero	1
3	4413.73828125000	3	Comedero	1
3	7818.46826172000	3	Comedero	1
3	2976.40917969000	3	Comedero	1
3	1847.16748047000	3	Comedero	1
3	701.37878418000	3	Comedero	1
3	1459.55737305000	3	Comedero	1
3	6706.46875000000	3	Comedero	1
3	4775.47167969000	3	Comedero	1
3	2070.05493164000	3	Comedero	1
3	7831.98681641000	3	Comedero	1
3	2099.29858398000	3	Comedero	1
3	724.59027099600	3	Comedero	1
3	4485.34033203000	3	Comedero	1
3	4674.61669922000	3	Comedero	1
3	1832.34350586000	3	Comedero	1
3	2001.15942383000	3	Comedero	1
3	7829.03271484000	3	Comedero	1
3	1529.92993164000	3	Comedero	1
3	9409.21972656000	3	Comedero	1
3	5091.51611328000	3	Comedero	1
3	8027.32324219000	3	Comedero	1
3	5688.14892578000	3	Comedero	1
3	2087.14428711000	3	Comedero	1
3	2284.52026367000	3	Comedero	1
3	6652.73046875000	3	Comedero	1
3	1500.28356934000	3	Comedero	1
3	5463.37060547000	3	Comedero	1
3	7023.23242188000	3	Comedero	1
3	7877.78466797000	3	Comedero	1
3	2219.25488281000	3	Comedero	1
3	8020.43505859000	3	Comedero	1
3	1625.35534668000	3	Comedero	1
3	2102.10888672000	3	Comedero	1
3	2470.20336914000	3	Comedero	1
3	7008.90917969000	3	Comedero	1
3	6503.10449219000	3	Comedero	1
3	1881.85632324000	3	Comedero	1
3	1370.49047852000	3	Comedero	1
3	2684.56420898000	3	Comedero	1
3	7745.53857422000	3	Comedero	1
3	997.75091552700	3	Comedero	1
3	7859.09716797000	3	Comedero	1
3	1652.29382324000	3	Comedero	1
3	5895.79394531000	3	Comedero	1
3	1507.45019531000	3	Comedero	1
3	2332.51416016000	3	Comedero	1
3	4814.53808594000	3	Comedero	1
3	5668.61083984000	3	Comedero	1
3	2990.61816406000	3	Comedero	1
3	5050.38671875000	3	Comedero	1

3	9362.25683594000	3	Comedero	1
3	4984.89843750000	3	Comedero	1
3	2071.48461914000	3	Comedero	1
3	6566.03759766000	3	Comedero	1
3	1512.07983398000	3	Comedero	1
3	1028.63122559000	3	Comedero	1
3	1404.55749512000	3	Comedero	1
3	4915.03759766000	3	Comedero	1
3	4543.68945313000	3	Comedero	1
3	2113.98339844000	3	Comedero	1
3	1538.82727051000	3	Comedero	1
3	1098.73889160000	3	Comedero	1
3	1152.52563477000	3	Comedero	1
3	1680.97607422000	3	Comedero	1
3	6411.86572266000	3	Comedero	1
3	8118.32275391000	3	Comedero	1
3	1243.83850098000	3	Comedero	1
3	1746.17785645000	3	Comedero	1
3	5441.91503906000	3	Comedero	1
3	5744.67382813000	3	Comedero	1
3	8190.24267578000	3	Comedero	1
3	2354.99365234000	3	Comedero	1
3	1326.72241211000	3	Comedero	1
3	2025.42309570000	3	Comedero	1
3	2104.68334961000	3	Comedero	1
3	2586.51464844000	3	Comedero	1
3	1342.26867676000	3	Comedero	1
3	1433.60681152000	3	Comedero	1
3	7750.94189453000	3	Comedero	1
3	5647.06835938000	3	Comedero	1
3	4962.46093750000	3	Comedero	1
3	5712.17480469000	3	Comedero	1
3	7986.07568359000	3	Comedero	1
3	1388.21166992000	3	Comedero	1
3	6039.91699219000	3	Comedero	1
3	1543.61071777000	3	Comedero	1
3	8381.75683594000	3	Comedero	1
3	1964.91467285000	3	Comedero	1
3	9879.02148438000	3	Comedero	1
3	1718.59143066000	3	Comedero	1
3	9347.72167969000	3	Comedero	1
3	1628.09948730000	3	Comedero	1
3	4839.18750000000	3	Comedero	1
3	5310.62207031000	3	Comedero	1
3	8763.84960938000	3	Comedero	1
3	8524.58203125000	3	Comedero	1
3	5100.84765625000	3	Comedero	1
3	4557.38378906000	3	Comedero	1
3	10074.56054690000	3	Comedero	1
3	5169.89306641000	3	Comedero	1
3	4601.89208984000	3	Comedero	1

3	5151.58105469000	3	Comedero	1
3	8477.26074219000	3	Comedero	1
3	4317.63623047000	3	Comedero	1
3	5251.40380859000	3	Comedero	1
3	3330.75073242000	3	Comedero	1
3	4452.96484375000	3	Comedero	1
3	2826.53442383000	3	Comedero	1
3	2810.78173828000	3	Comedero	1
3	3212.49975586000	3	Comedero	1
3	3179.06469727000	3	Comedero	1
3	8566.82031250000	3	Comedero	1
3	5044.85498047000	3	Comedero	1
3	2839.59033203000	3	Comedero	1
3	3154.54663086000	3	Comedero	1
3	5552.23437500000	3	Comedero	1
3	3518.26879883000	3	Comedero	1
3	6792.84472656000	3	Comedero	1
3	4046.27294922000	3	Comedero	1
3	3678.26074219000	3	Comedero	1
3	4543.95361328000	3	Comedero	1
3	3415.66796875000	3	Comedero	1
3	9789.39746094000	3	Comedero	1
3	10240.80761720000	3	Comedero	1
3	3779.94799805000	3	Comedero	1
3	8836.14453125000	3	Comedero	1
3	9744.12695313000	3	Comedero	1
3	10282.14941410000	3	Comedero	1
3	9923.56250000000	3	Comedero	1
3	9406.95019531000	3	Comedero	1
3	4378.55566406000	3	Comedero	1
3	6206.40478516000	3	Comedero	1
3	5419.22998047000	3	Comedero	1
3	4933.64160156000	3	Comedero	1
3	6733.36181641000	3	Comedero	1
3	6835.01025391000	3	Comedero	1
3	9982.37597656000	3	Comedero	1
3	6949.26708984000	3	Comedero	1
3	7366.77294922000	3	Comedero	1
3	6970.37060547000	3	Comedero	1
3	7133.60839844000	3	Comedero	1
3	7605.54443359000	3	Comedero	1
3	7903.62402344000	3	Comedero	1
3	7957.73242188000	3	Comedero	1
3	7750.53662109000	3	Comedero	1
3	7830.08984375000	3	Comedero	1
3	7761.63232422000	3	Comedero	1
3	8293.08203125000	3	Comedero	1
3	8392.86718750000	3	Comedero	1
3	8518.17578125000	3	Comedero	1
3	8801.50585938000	3	Comedero	1
3	9013.09179688000	3	Comedero	1

3	9696.13476563000	3	Comedero	1
3	10073.55859380000	3	Comedero	1
3	9514.09765625000	3	Comedero	1
3	10229.95214840000	3	Comedero	1
3	9754.64648438000	3	Comedero	1
3	10402.62011720000	3	Comedero	1
3	10806.08789060000	3	Comedero	1
3	10821.03417970000	3	Comedero	1
3	11327.50976560000	3	Comedero	1
3	11696.97070310000	3	Comedero	1
3	12098.40820310000	3	Comedero	1
3	11459.03613280000	3	Comedero	1
3	10925.93945310000	3	Comedero	1
3	12125.40820310000	3	Comedero	1
3	11874.24804690000	3	Comedero	1
3	11879.91210940000	3	Comedero	1
3	11064.72265630000	3	Comedero	1
3	13338.10937500000	3	Comedero	1
3	12810.60351560000	3	Comedero	2
3	11867.34765630000	3	Comedero	2
3	12192.62304690000	3	Comedero	2
3	11666.76953130000	3	Comedero	2
3	10382.60546880000	3	Comedero	2
3	10457.95410160000	3	Comedero	2
3	10362.60058590000	3	Comedero	2
3	10162.63183590000	3	Comedero	2
3	9966.28417969000	3	Comedero	2
3	9661.67675781000	3	Comedero	2
3	10099.10644530000	3	Comedero	2
3	9306.82421875000	3	Comedero	2
3	9718.35058594000	3	Comedero	2
3	8603.19433594000	3	Comedero	2
3	8291.82324219000	3	Comedero	2
3	8357.25585938000	3	Comedero	2
3	6402.03906250000	3	Comedero	2
3	7275.08496094000	3	Comedero	2
3	6990.94726563000	3	Comedero	2
3	6531.54150391000	3	Comedero	2
3	4903.00292969000	3	Comedero	2
3	5200.92138672000	3	Comedero	2
3	6129.12890625000	3	Comedero	2
3	6101.83789063000	3	Comedero	2
3	5887.01318359000	3	Comedero	2
3	5838.58789063000	3	Comedero	2
3	5569.97656250000	3	Comedero	2
3	5373.16259766000	3	Comedero	2
3	5637.61425781000	3	Comedero	2
3	4291.89355469000	3	Comedero	2
3	4695.15185547000	3	Comedero	2
3	6046.82031250000	3	Comedero	2
3	5021.49804688000	3	Comedero	2

3	4546.08447266000	3	Comedero	2
3	4078.14331055000	3	Comedero	2
3	4364.26611328000	3	Comedero	2
3	8793.68164063000	3	Comedero	2
3	4095.27636719000	3	Comedero	2
3	4213.16699219000	3	Comedero	2
3	3838.49951172000	3	Comedero	2
3	4233.93701172000	3	Comedero	2
3	3980.59619141000	3	Comedero	2
3	2552.70654297000	3	Comedero	2
3	3746.24072266000	3	Comedero	2
3	1757.62170410000	3	Comedero	2
3	2974.63110352000	3	Comedero	2
3	2963.39453125000	3	Comedero	2
3	3088.99438477000	3	Comedero	2
3	1518.13098145000	3	Comedero	2
3	3599.30419922000	3	Comedero	2
3	3595.31738281000	3	Comedero	2
3	2641.14746094000	3	Comedero	2
3	1367.18078613000	3	Comedero	2
3	3593.57495117000	3	Comedero	2
3	2725.79199219000	3	Comedero	2
3	2722.34448242000	3	Comedero	2
3	3378.25708008000	3	Comedero	2
3	8409.66796875000	3	Comedero	2
3	2981.57666016000	3	Comedero	2
3	2002.79333496000	3	Comedero	2
3	3258.46093750000	3	Comedero	2
3	1840.21289063000	3	Comedero	2
3	7766.31103516000	3	Comedero	2
3	1470.99255371000	3	Comedero	2
3	3469.56103516000	3	Comedero	2
3	1276.88317871000	3	Comedero	2
3	1555.35827637000	3	Comedero	2
3	3450.52783203000	3	Comedero	2
3	7182.76074219000	3	Comedero	2
3	1469.10827637000	3	Comedero	2
3	2590.08984375000	3	Comedero	2
3	848.80718994100	3	Comedero	2
3	3844.92114258000	3	Comedero	2
3	2910.36743164000	3	Comedero	2
3	6108.00244141000	3	Comedero	2
3	1515.00720215000	3	Comedero	2
3	1535.58532715000	3	Comedero	2
3	730.72888183600	3	Comedero	2
3	8802.21777344000	3	Comedero	2
3	1660.34362793000	3	Comedero	2
3	477.63763427700	3	Comedero	2
3	2244.36230469000	3	Comedero	2
3	2058.57568359000	3	Comedero	2
3	4364.55957031000	3	Comedero	2

3	6319.29052734000	3	Comedero	2
3	1053.88696289000	3	Comedero	2
3	2439.09350586000	3	Comedero	2
3	2336.25341797000	3	Comedero	2
3	2297.13720703000	3	Comedero	2
3	1026.21008301000	3	Comedero	2
3	2353.84912109000	3	Comedero	2
3	2836.86718750000	3	Comedero	2
3	2524.33349609000	3	Comedero	2
3	1932.86987305000	3	Comedero	2
3	4885.44384766000	3	Comedero	2
3	2802.36962891000	3	Comedero	2
3	1976.37927246000	3	Comedero	2
3	1757.37976074000	3	Comedero	2
3	1901.65942383000	3	Comedero	2
3	2228.75903320000	3	Comedero	2
3	5299.05712891000	3	Comedero	2
3	8771.53710938000	3	Comedero	2
3	5385.42431641000	3	Comedero	2
3	3102.01562500000	3	Comedero	2
3	7722.20947266000	3	Comedero	2
3	5496.69335938000	3	Comedero	2
3	6448.62597656000	3	Comedero	2
3	6432.01416016000	3	Comedero	2
3	6625.42333984000	3	Comedero	2
3	6887.13037109000	3	Comedero	2
3	10011.30957030000	3	Comedero	3
3	9307.67578125000	3	Comedero	3
3	6674.14843750000	3	Comedero	3
3	6367.78466797000	3	Comedero	3
3	4900.54150391000	3	Comedero	3
3	3691.82275391000	3	Comedero	3
3	4143.00048828000	3	Comedero	3
3	2959.95312500000	3	Comedero	3
3	3690.26879883000	3	Comedero	3
3	3781.62060547000	3	Comedero	3
3	3333.17309570000	3	Comedero	3
3	3486.86694336000	3	Comedero	3
3	3161.11474609000	3	Comedero	3
3	2721.45361328000	3	Comedero	3
3	6452.18310547000	3	Comedero	3
3	2970.91308594000	3	Comedero	3
3	1766.55725098000	3	Comedero	3
3	149.38740539600	3	Comedero	3
3	1862.80566406000	3	Comedero	3
3	6833.01611328000	3	Comedero	3
3	3002.92822266000	3	Comedero	3
3	2759.64453125000	3	Comedero	3
3	5534.40527344000	3	Comedero	3
3	8012.27294922000	3	Comedero	3
3	4579.78222656000	3	Comedero	4

3	4421.60693359000	3	Comedero	4
3	1554.30834961000	3	Comedero	4
3	3026.71191406000	3	Comedero	4
3	967.85968017600	3	Comedero	4
3	3162.43139648000	3	Comedero	4
3	3570.57031250000	3	Comedero	4
3	2557.22387695000	3	Comedero	4
3	6928.57128906000	3	Comedero	4
3	909.05786132800	3	Comedero	4
3	2484.22753906000	3	Comedero	4
3	1426.27612305000	3	Comedero	4
3	1355.25903320000	3	Comedero	4
3	1625.15014648000	3	Comedero	4
3	1833.77038574000	3	Comedero	4
3	1766.75183105000	3	Comedero	4

Source Site: Group 11K-6

Start Type	**Pathcosts**	**Zone**	***Sian Otot***	**End Type**
4	13826.56835940000	2	El Bosque	1
4	13833.12304690000	2	El Bosque	1
4	13661.38281250000	2	El Bosque	1
4	13539.51562500000	2	El Bosque	1
4	13171.37695310000	2	El Bosque	1
4	14751.29492190000	2	El Bosque	1
4	12737.05078130000	2	El Bosque	1
4	14519.93066410000	2	El Bosque	1
4	13063.54101560000	2	El Bosque	1
4	12803.85058590000	2	El Bosque	1
4	12903.27734380000	2	El Bosque	1
4	12538.80664060000	2	El Bosque	1
4	12499.68847660000	2	El Bosque	1
4	12497.24707030000	2	El Bosque	1
4	12379.23046880000	2	El Bosque	1
4	12243.49804690000	2	El Bosque	1
4	12210.70800780000	2	El Bosque	1
4	12950.87402340000	2	El Bosque	1
4	13110.00097660000	2	El Bosque	1
4	11968.43359380000	2	El Bosque	1
4	11792.73144530000	2	El Bosque	1
4	11472.57226560000	2	El Bosque	1
4	12898.04394530000	2	El Bosque	1
4	11334.79199220000	2	El Bosque	1
4	12033.32226560000	2	El Bosque	1
4	11462.98632810000	2	El Bosque	1
4	11678.30468750000	2	El Bosque	1
4	11217.69628910000	2	El Bosque	1
4	11228.00390630000	2	El Bosque	1
4	11246.58300780000	2	El Bosque	1

4	11092.93457030000	2	El Bosque	1
4	11134.58105470000	2	El Bosque	1
4	10876.82031250000	2	El Bosque	1
4	10620.31445310000	2	El Bosque	1
4	11564.62207030000	2	El Bosque	1
4	10903.93750000000	2	El Bosque	1
4	10571.31054690000	2	El Bosque	1
4	10833.63574220000	2	El Bosque	1
4	10762.80566410000	2	El Bosque	1
4	10645.69238280000	2	El Bosque	1
4	10677.22851560000	2	El Bosque	1
4	10807.97070310000	2	El Bosque	1
4	10707.87402340000	2	El Bosque	1
4	10582.99804690000	2	El Bosque	1
4	10500.59765630000	2	El Bosque	1
4	12333.96582030000	2	El Bosque	1
4	12543.21875000000	2	El Bosque	1
4	10928.71777340000	2	El Bosque	1
4	10631.24121090000	2	El Bosque	1
4	10319.22167970000	2	El Bosque	1
4	10532.57324220000	2	El Bosque	1
4	10500.05273440000	2	El Bosque	1
4	10186.26855470000	2	El Bosque	1
4	10551.93945310000	2	El Bosque	1
4	10484.56445310000	2	El Bosque	1
4	9936.32421875000	2	El Bosque	1
4	9783.82714844000	2	El Bosque	1
4	9595.60253906000	2	El Bosque	1
4	9621.78222656000	2	El Bosque	1
4	9421.48632813000	2	El Bosque	1
4	9271.77050781000	2	El Bosque	1
4	8969.05371094000	2	El Bosque	1
4	8804.78027344000	2	El Bosque	1
4	8694.01269531000	2	El Bosque	1
4	8580.20214844000	2	El Bosque	1
4	8650.60253906000	2	El Bosque	1
4	8482.91699219000	2	El Bosque	1
4	8506.08593750000	2	El Bosque	1
4	8325.14257813000	2	El Bosque	1
4	8994.91015625000	2	El Bosque	1
4	8609.96484375000	2	El Bosque	1
4	8533.04492188000	2	El Bosque	1
4	8032.91064453000	2	El Bosque	1
4	8137.89208984000	2	El Bosque	1
4	8183.60693359000	2	El Bosque	1
4	8078.15087891000	2	El Bosque	1
4	7747.57958984000	2	El Bosque	1
4	7368.68945313000	2	El Bosque	1
4	7624.54345703000	2	El Bosque	1
4	7492.17333984000	2	El Bosque	1
4	7648.19921875000	2	El Bosque	1

4	7722.65527344000	2	El Bosque	1
4	7095.93945313000	2	El Bosque	1
4	7494.14892578000	2	El Bosque	1
4	7010.15673828000	2	El Bosque	1
4	7464.78320313000	2	El Bosque	1
4	7051.71728516000	2	El Bosque	1
4	6954.46533203000	2	El Bosque	1
4	7212.69384766000	2	El Bosque	1
4	7027.67236328000	2	El Bosque	1
4	10166.43066410000	2	El Bosque	1
4	6574.39599609000	2	El Bosque	1
4	6685.82812500000	2	El Bosque	1
4	6474.62158203000	2	El Bosque	1
4	6636.85058594000	2	El Bosque	1
4	6973.01708984000	2	El Bosque	1
4	6351.22851563000	2	El Bosque	1
4	6718.11718750000	2	El Bosque	1
4	6360.90087891000	2	El Bosque	1
4	6321.96972656000	2	El Bosque	1
4	6663.19384766000	2	El Bosque	1
4	6096.10302734000	2	El Bosque	1
4	7505.47802734000	2	El Bosque	1
4	6199.13476563000	2	El Bosque	1
4	6304.06689453000	2	El Bosque	1
4	7024.56787109000	2	El Bosque	1
4	7288.97363281000	2	El Bosque	1
4	9413.42871094000	2	El Bosque	1
4	8261.25390625000	2	El Bosque	1
4	6230.22998047000	2	El Bosque	1
4	6050.33349609000	2	El Bosque	1
4	6235.32421875000	2	El Bosque	1
4	5920.02343750000	2	El Bosque	1
4	6154.11962891000	2	El Bosque	1
4	9862.92675781000	2	El Bosque	1
4	6182.75781250000	2	El Bosque	1
4	6222.40429688000	2	El Bosque	1
4	6629.03417969000	2	El Bosque	1
4	6023.09570313000	2	El Bosque	1
4	5878.22363281000	2	El Bosque	1
4	6067.73242188000	2	El Bosque	1
4	5947.12451172000	2	El Bosque	1
4	5953.45166016000	2	El Bosque	1
4	5644.45556641000	2	El Bosque	1
4	5779.73925781000	2	El Bosque	1
4	9577.21289063000	2	El Bosque	1
4	7030.81201172000	2	El Bosque	1
4	6869.08203125000	2	El Bosque	1
4	5831.93261719000	2	El Bosque	1
4	5596.47460938000	2	El Bosque	1
4	6534.17382813000	2	El Bosque	1
4	5451.35107422000	2	El Bosque	1

4	5807.06738281000	2	El Bosque	1
4	5645.87792969000	2	El Bosque	1
4	5560.51806641000	2	El Bosque	1
4	5523.96679688000	2	El Bosque	1
4	5767.10937500000	2	El Bosque	1
4	5493.57128906000	2	El Bosque	1
4	5323.06103516000	2	El Bosque	1
4	8530.04589844000	2	El Bosque	1
4	5202.47460938000	2	El Bosque	1
4	8656.48144531000	2	El Bosque	1
4	6254.61425781000	2	El Bosque	1
4	4990.64355469000	2	El Bosque	1
4	6558.21826172000	2	El Bosque	1
4	5071.12597656000	2	El Bosque	1
4	4792.31738281000	2	El Bosque	1
4	5023.81835938000	2	El Bosque	1
4	5067.74267578000	2	El Bosque	1
4	5151.02246094000	2	El Bosque	1
4	4981.96386719000	2	El Bosque	1
4	8727.77246094000	2	El Bosque	1
4	7247.78808594000	2	El Bosque	1
4	5701.00390625000	2	El Bosque	1
4	4898.25927734000	2	El Bosque	1
4	4858.54394531000	2	El Bosque	1
4	8792.43652344000	2	El Bosque	1
4	4679.88134766000	2	El Bosque	1
4	4534.03271484000	2	El Bosque	1
4	6643.61767578000	2	El Bosque	1
4	4450.96142578000	2	El Bosque	1
4	8053.49023438000	2	El Bosque	1
4	4519.58984375000	2	El Bosque	1
4	4520.13916016000	2	El Bosque	1
4	6700.98974609000	2	El Bosque	1
4	7444.83105469000	2	El Bosque	1
4	9256.18359375000	2	El Bosque	1
4	7542.81298828000	2	El Bosque	1
4	4327.09912109000	2	El Bosque	1
4	6350.77978516000	2	El Bosque	1
4	7605.86621094000	2	El Bosque	1
4	4394.42236328000	2	El Bosque	1
4	9302.55859375000	2	El Bosque	1
4	4139.48193359000	2	El Bosque	1
4	6751.36816406000	2	El Bosque	1
4	6523.72753906000	2	El Bosque	1
4	4119.96630859000	2	El Bosque	1
4	7083.93408203000	2	El Bosque	1
4	8291.32617188000	2	El Bosque	1
4	4007.37231445000	2	El Bosque	1
4	7189.23681641000	2	El Bosque	1
4	4068.85546875000	2	El Bosque	1
4	4335.57812500000	2	El Bosque	1

4	4181.86132813000	2	El Bosque	1
4	6865.99218750000	2	El Bosque	1
4	4247.94140625000	2	El Bosque	1
4	9406.65917969000	2	El Bosque	1
4	3594.60058594000	2	El Bosque	1
4	3767.53979492000	2	El Bosque	1
4	3485.88305664000	2	El Bosque	1
4	3666.74926758000	2	El Bosque	1
4	3590.86718750000	2	El Bosque	1
4	3950.04980469000	2	El Bosque	1
4	3647.84423828000	2	El Bosque	1
4	3745.22558594000	2	El Bosque	1
4	3621.32250977000	2	El Bosque	1
4	3627.57299805000	2	El Bosque	1
4	3633.47924805000	2	El Bosque	1
4	3835.50390625000	2	El Bosque	1
4	3379.31811523000	2	El Bosque	1
4	3504.64965820000	2	El Bosque	1
4	3435.18066406000	2	El Bosque	1
4	3844.22143555000	2	El Bosque	1
4	3730.20458984000	2	El Bosque	1
4	3207.42285156000	2	El Bosque	1
4	3449.33496094000	2	El Bosque	1
4	3141.52587891000	2	El Bosque	1
4	3158.40625000000	2	El Bosque	1
4	3170.29663086000	2	El Bosque	1
4	3978.54125977000	2	El Bosque	1
4	3717.28588867000	2	El Bosque	1
4	3163.62402344000	2	El Bosque	1
4	2987.39257813000	2	El Bosque	1
4	3129.55297852000	2	El Bosque	1
4	3194.78027344000	2	El Bosque	1
4	3033.91357422000	2	El Bosque	1
4	3151.75683594000	2	El Bosque	1
4	3510.33129883000	2	El Bosque	1
4	2820.59765625000	2	El Bosque	1
4	2749.59033203000	2	El Bosque	1
4	3664.62768555000	2	El Bosque	1
4	2728.56762695000	2	El Bosque	1
4	2926.63281250000	2	El Bosque	1
4	7547.16015625000	2	El Bosque	1
4	8287.14453125000	2	El Bosque	1
4	2980.72729492000	2	El Bosque	1
4	3063.53100586000	2	El Bosque	1
4	3126.87768555000	2	El Bosque	1
4	3066.11108398000	2	El Bosque	1
4	8455.96875000000	2	El Bosque	1
4	2807.13183594000	2	El Bosque	1
4	2983.62084961000	2	El Bosque	1
4	7077.30224609000	2	El Bosque	1
4	5874.76025391000	2	El Bosque	1

4	2718.72998047000	2	El Bosque	1
4	3176.20654297000	2	El Bosque	1
4	9104.20800781000	2	El Bosque	1
4	6875.54003906000	2	El Bosque	1
4	3086.47973633000	2	El Bosque	1
4	8747.54394531000	2	El Bosque	1
4	2491.72973633000	2	El Bosque	1
4	8092.83447266000	2	El Bosque	1
4	8344.11035156000	2	El Bosque	1
4	5546.40234375000	2	El Bosque	1
4	3012.06713867000	2	El Bosque	1
4	6419.36962891000	2	El Bosque	1
4	7786.67773438000	2	El Bosque	1
4	9438.78710938000	2	El Bosque	1
4	6486.13964844000	2	El Bosque	1
4	7761.18066406000	2	El Bosque	1
4	6036.93066406000	2	El Bosque	1
4	7807.74853516000	2	El Bosque	1
4	9002.82910156000	2	El Bosque	1
4	5683.95312500000	2	El Bosque	1
4	8112.69531250000	2	El Bosque	1
4	4963.23046875000	2	El Bosque	1
4	9704.21386719000	2	El Bosque	1
4	6567.14306641000	2	El Bosque	1
4	6238.78662109000	2	El Bosque	1
4	7860.56933594000	2	El Bosque	1
4	9161.04687500000	2	El Bosque	1
4	5495.06494141000	2	El Bosque	1
4	5796.23242188000	2	El Bosque	1
4	2262.17382813000	2	El Bosque	1
4	1491.81066895000	2	El Bosque	1
4	5976.74023438000	2	El Bosque	1
4	9213.81445313000	2	El Bosque	1
4	9654.33789063000	2	El Bosque	1
4	8811.85351563000	2	El Bosque	1
4	4099.61279297000	2	El Bosque	1
4	7860.20947266000	2	El Bosque	1
4	4521.53271484000	2	El Bosque	1
4	1214.01477051000	2	El Bosque	1
4	2085.44628906000	2	El Bosque	1
4	1355.35107422000	2	El Bosque	1
4	8135.82031250000	2	El Bosque	1
4	4359.10546875000	2	El Bosque	1
4	1255.72070313000	2	El Bosque	1
4	7870.48046875000	2	El Bosque	1
4	3955.48388672000	2	El Bosque	1
4	2036.25256348000	2	El Bosque	1
4	3862.94604492000	2	El Bosque	1
4	4136.01464844000	2	El Bosque	1
4	1010.98175049000	2	El Bosque	1
4	3785.76245117000	2	El Bosque	1

4	9258.37792969000	2	El Bosque	1
4	1069.48132324000	2	El Bosque	1
4	9290.15136719000	2	El Bosque	1
4	4471.36816406000	2	El Bosque	1
4	9456.66796875000	2	El Bosque	1
4	5437.28955078000	2	El Bosque	1
4	1006.01940918000	2	El Bosque	1
4	3766.96679688000	2	El Bosque	1
4	8082.08154297000	2	El Bosque	1
4	969.95593261700	2	El Bosque	1
4	4939.85839844000	2	El Bosque	1
4	8452.58496094000	2	El Bosque	1
4	9307.12988281000	2	El Bosque	1
4	1004.08947754000	2	El Bosque	1
4	7771.38525391000	2	El Bosque	1
4	781.74755859400	2	El Bosque	1
4	767.96838378900	2	El Bosque	1
4	3914.54150391000	2	El Bosque	1
4	6674.55761719000	2	El Bosque	1
4	6189.58056641000	2	El Bosque	1
4	524.22760009800	2	El Bosque	1
4	840.55377197300	2	El Bosque	1
4	1358.20886230000	2	El Bosque	1
4	9174.89257813000	2	El Bosque	1
4	1958.03356934000	2	El Bosque	1
4	7524.13183594000	2	El Bosque	1
4	541.52770996100	2	El Bosque	1
4	5173.79736328000	2	El Bosque	1
4	636.49035644500	2	El Bosque	1
4	766.69256591800	2	El Bosque	1
4	3792.92309570000	2	El Bosque	1
4	4830.14843750000	2	El Bosque	1
4	1626.31530762000	2	El Bosque	1
4	4064.44384766000	2	El Bosque	1
4	8996.43652344000	2	El Bosque	1
4	3935.25512695000	2	El Bosque	1
4	447.56692504900	2	El Bosque	1
4	5905.78076172000	2	El Bosque	1
4	437.79757690400	2	El Bosque	1
4	1831.09814453000	2	El Bosque	1
4	507.24380493200	2	El Bosque	1
4	3559.09814453000	2	El Bosque	1
4	3187.75170898000	2	El Bosque	1
4	484.76812744100	2	El Bosque	1
4	3956.96020508000	2	El Bosque	1
4	311.13900756800	2	El Bosque	1
4	1611.95007324000	2	El Bosque	1
4	411.22207641600	2	El Bosque	1
4	1380.38757324000	2	El Bosque	1
4	156.73161315900	2	El Bosque	1
4	5413.05175781000	2	El Bosque	1

4	9547.68359375000	2	El Bosque	1
4	918.99829101600	2	El Bosque	1
4	324.35943603500	2	El Bosque	1
4	4042.90795898000	2	El Bosque	1
4	4477.49658203000	2	El Bosque	1
4	9619.58984375000	2	El Bosque	1
4	720.20812988300	2	El Bosque	1
4	848.32733154300	2	El Bosque	1
4	412.34765625000	2	El Bosque	1
4	488.86779785200	2	El Bosque	1
4	970.69940185500	2	El Bosque	1
4	928.44104003900	2	El Bosque	1
4	1149.58679199000	2	El Bosque	1
4	6855.86328125000	2	El Bosque	1
4	4048.68261719000	2	El Bosque	1
4	3366.96972656000	2	El Bosque	1
4	4142.79638672000	2	El Bosque	1
4	7094.82373047000	2	El Bosque	1
4	1295.43273926000	2	El Bosque	1
4	4703.73828125000	2	El Bosque	1
4	1124.16882324000	2	El Bosque	1
4	7506.08935547000	2	El Bosque	1
4	492.83541870100	2	El Bosque	1
4	9317.33886719000	2	El Bosque	1
4	612.04705810500	2	El Bosque	1
4	8574.13085938000	2	El Bosque	1
4	801.84588623000	2	El Bosque	1
4	3223.37353516000	2	El Bosque	1
4	3694.81420898000	2	El Bosque	1
4	10193.19238280000	2	El Bosque	1
4	9953.93261719000	2	El Bosque	1
4	3485.02954102000	2	El Bosque	1
4	2941.56762695000	2	El Bosque	1
4	9171.86816406000	2	El Bosque	1
4	6599.24218750000	2	El Bosque	1
4	5929.01318359000	2	El Bosque	1
4	6580.93261719000	2	El Bosque	1
4	9906.61132813000	2	El Bosque	1
4	5627.39355469000	2	El Bosque	1
4	6680.75341797000	2	El Bosque	1
4	4599.00048828000	2	El Bosque	1
4	5762.72265625000	2	El Bosque	1
4	3086.37963867000	2	El Bosque	1
4	3199.02636719000	2	El Bosque	1
4	1981.95178223000	2	El Bosque	1
4	2128.91943359000	2	El Bosque	1
4	9996.15820313000	2	El Bosque	1
4	6354.60351563000	2	El Bosque	1
4	3227.83496094000	2	El Bosque	1
4	2782.16284180000	2	El Bosque	1
4	6981.58398438000	2	El Bosque	1

4	4786.51708984000	2	El Bosque	1
4	8222.19238281000	2	El Bosque	1
4	5314.52587891000	2	El Bosque	1
4	2292.88842773000	2	El Bosque	1
4	5812.20654297000	2	El Bosque	1
4	2894.95996094000	2	El Bosque	1
4	8370.32128906000	2	El Bosque	1
4	11670.14746090000	2	El Bosque	1
4	2209.31372070000	2	El Bosque	1
4	10265.47851560000	2	El Bosque	1
4	8325.05175781000	2	El Bosque	1
4	11711.48925780000	2	El Bosque	1
4	11352.90234380000	2	El Bosque	1
4	10836.29003910000	2	El Bosque	1
4	5646.80322266000	2	El Bosque	1
4	7635.75341797000	2	El Bosque	1
4	3803.41259766000	2	El Bosque	1
4	3363.00756836000	2	El Bosque	1
4	8043.11328125000	2	El Bosque	1
4	8144.76171875000	2	El Bosque	1
4	11411.72949220000	2	El Bosque	1
4	8259.01953125000	2	El Bosque	1
4	8796.11523438000	2	El Bosque	1
4	8280.12207031000	2	El Bosque	1
4	8443.35742188000	2	El Bosque	1
4	8915.29492188000	2	El Bosque	1
4	9332.98046875000	2	El Bosque	1
4	9335.05566406000	2	El Bosque	1
4	9060.29687500000	2	El Bosque	1
4	9139.83203125000	2	El Bosque	1
4	9071.38867188000	2	El Bosque	1
4	9722.42871094000	2	El Bosque	1
4	9772.92968750000	2	El Bosque	1
4	9827.92675781000	2	El Bosque	1
4	10230.85351560000	2	El Bosque	1
4	10442.44042970000	2	El Bosque	1
4	11125.48730470000	2	El Bosque	1
4	11502.91113280000	2	El Bosque	1
4	10865.72460940000	2	El Bosque	1
4	11659.29785160000	2	El Bosque	1
4	11109.36621090000	2	El Bosque	1
4	11831.96875000000	2	El Bosque	1
4	12235.44921880000	2	El Bosque	1
4	12250.38281250000	2	El Bosque	1
4	12756.86230470000	2	El Bosque	1
4	13126.32324220000	2	El Bosque	1
4	13527.76171880000	2	El Bosque	1
4	12888.38964840000	2	El Bosque	1
4	12355.28808590000	2	El Bosque	1
4	13554.76074220000	2	El Bosque	1
4	13303.60058590000	2	El Bosque	1

4	13309.26562500000	2	El Bosque	1
4	12332.97460940000	2	El Bosque	1
4	14767.46191410000	2	El Bosque	1
4	13168.06835940000	2	El Bosque	2
4	12927.15527340000	2	El Bosque	2
4	12550.08789060000	2	El Bosque	2
4	12732.50585940000	2	El Bosque	2
4	10740.07031250000	2	El Bosque	2
4	10815.41894530000	2	El Bosque	2
4	10720.06542970000	2	El Bosque	2
4	10520.09667970000	2	El Bosque	2
4	10323.74902340000	2	El Bosque	2
4	10019.14648440000	2	El Bosque	2
4	10456.57128910000	2	El Bosque	2
4	9664.28808594000	2	El Bosque	2
4	10075.81542970000	2	El Bosque	2
4	8960.66308594000	2	El Bosque	2
4	8649.29199219000	2	El Bosque	2
4	8714.72558594000	2	El Bosque	2
4	7530.49609375000	2	El Bosque	2
4	7632.55371094000	2	El Bosque	2
4	7348.41601563000	2	El Bosque	2
4	6889.01025391000	2	El Bosque	2
4	6604.09716797000	2	El Bosque	2
4	6276.34130859000	2	El Bosque	2
4	6696.35351563000	2	El Bosque	2
4	6459.31005859000	2	El Bosque	2
4	6419.91064453000	2	El Bosque	2
4	6254.65283203000	2	El Bosque	2
4	5927.44531250000	2	El Bosque	2
4	6189.70996094000	2	El Bosque	2
4	5995.08593750000	2	El Bosque	2
4	5327.02441406000	2	El Bosque	2
4	5481.73291016000	2	El Bosque	2
4	6404.28906250000	2	El Bosque	2
4	5378.96679688000	2	El Bosque	2
4	5140.90087891000	2	El Bosque	2
4	5107.75341797000	2	El Bosque	2
4	4721.73632813000	2	El Bosque	2
4	9151.14550781000	2	El Bosque	2
4	4531.40820313000	2	El Bosque	2
4	4570.63769531000	2	El Bosque	2
4	4348.63964844000	2	El Bosque	2
4	6962.87255859000	2	El Bosque	2
4	4338.06542969000	2	El Bosque	2
4	4183.84765625000	2	El Bosque	2
4	4103.71044922000	2	El Bosque	2
4	3914.45678711000	2	El Bosque	2
4	3790.78320313000	2	El Bosque	2
4	3661.75561523000	2	El Bosque	2
4	3693.11425781000	2	El Bosque	2

4	3675.23095703000	2	El Bosque	2
4	3956.77392578000	2	El Bosque	2
4	3952.78735352000	2	El Bosque	2
4	3550.97338867000	2	El Bosque	2
4	3858.76269531000	2	El Bosque	2
4	3951.04467773000	2	El Bosque	2
4	3409.98852539000	2	El Bosque	2
4	3245.77612305000	2	El Bosque	2
4	3735.72680664000	2	El Bosque	2
4	8767.13378906000	2	El Bosque	2
4	3339.04663086000	2	El Bosque	2
4	3052.83056641000	2	El Bosque	2
4	3615.93066406000	2	El Bosque	2
4	3001.58300781000	2	El Bosque	2
4	8123.77978516000	2	El Bosque	2
4	2984.85913086000	2	El Bosque	2
4	3827.03076172000	2	El Bosque	2
4	3005.84497070000	2	El Bosque	2
4	2765.88549805000	2	El Bosque	2
4	3807.99755859000	2	El Bosque	2
4	8623.65917969000	2	El Bosque	2
4	2480.75366211000	2	El Bosque	2
4	2947.55981445000	2	El Bosque	2
4	2700.39282227000	2	El Bosque	2
4	5787.14453125000	2	El Bosque	2
4	3267.83715820000	2	El Bosque	2
4	7548.90771484000	2	El Bosque	2
4	2088.22241211000	2	El Bosque	2
4	1961.86938477000	2	El Bosque	2
4	2175.71142578000	2	El Bosque	2
4	8949.95898438000	2	El Bosque	2
4	1682.80749512000	2	El Bosque	2
4	2510.23706055000	2	El Bosque	2
4	1755.04370117000	2	El Bosque	2
4	1565.89660645000	2	El Bosque	2
4	3921.76635742000	2	El Bosque	2
4	6379.81982422000	2	El Bosque	2
4	1479.02941895000	2	El Bosque	2
4	1626.36389160000	2	El Bosque	2
4	1221.66601563000	2	El Bosque	2
4	1071.68884277000	2	El Bosque	2
4	1435.50866699000	2	El Bosque	2
4	890.78216552700	2	El Bosque	2
4	1450.28979492000	2	El Bosque	2
4	1095.19641113000	2	El Bosque	2
4	313.40783691400	2	El Bosque	2
4	3529.50708008000	2	El Bosque	2
4	1252.29382324000	2	El Bosque	2
4	350.23010253900	2	El Bosque	2
4	418.62683105500	2	El Bosque	2
4	331.02416992200	2	El Bosque	2

4	615.68414306600	2	El Bosque	2
4	3683.23950195000	2	El Bosque	2
4	10200.87988280000	2	El Bosque	2
4	3769.60644531000	2	El Bosque	2
4	1609.08569336000	2	El Bosque	2
4	9151.55566406000	2	El Bosque	2
4	3880.87255859000	2	El Bosque	2
4	7877.97460938000	2	El Bosque	2
4	7861.36279297000	2	El Bosque	2
4	8054.77197266000	2	El Bosque	2
4	8199.55468750000	2	El Bosque	2
4	10368.77441410000	2	El Bosque	3
4	9665.14160156000	2	El Bosque	3
4	7031.61718750000	2	El Bosque	3
4	6762.01025391000	2	El Bosque	3
4	5324.55761719000	2	El Bosque	3
4	4049.29296875000	2	El Bosque	3
4	4500.46728516000	2	El Bosque	3
4	3933.77587891000	2	El Bosque	3
4	4047.73852539000	2	El Bosque	3
4	4139.09033203000	2	El Bosque	3
4	3690.64282227000	2	El Bosque	3
4	3844.33666992000	2	El Bosque	3
4	3518.58447266000	2	El Bosque	3
4	3128.18652344000	2	El Bosque	3
4	7893.08837891000	2	El Bosque	3
4	3328.38281250000	2	El Bosque	3
4	3209.50000000000	2	El Bosque	3
4	2179.41113281000	2	El Bosque	3
4	2989.00756836000	2	El Bosque	3
4	2046.08886719000	2	El Bosque	3
4	8262.36816406000	2	El Bosque	3
4	1387.11291504000	2	El Bosque	3
4	1143.83020020000	2	El Bosque	3
4	6963.75488281000	2	El Bosque	3
4	9322.02050781000	2	El Bosque	3
4	5012.24316406000	2	El Bosque	4
4	4779.07714844000	2	El Bosque	4
4	4283.24316406000	2	El Bosque	4
4	3444.37915039000	2	El Bosque	4
4	3030.86572266000	2	El Bosque	4
4	3519.90112305000	2	El Bosque	4
4	3928.04003906000	2	El Bosque	4
4	2914.69360352000	2	El Bosque	4
4	8369.48437500000	2	El Bosque	4
4	2265.00854492000	2	El Bosque	4
4	2841.69775391000	2	El Bosque	4
4	4035.98657227000	2	El Bosque	4
4	1836.03771973000	2	El Bosque	4
4	1716.11511230000	2	El Bosque	4
4	1458.11450195000	2	El Bosque	4

Source Site: Group 10L-18

Start Type	Pathcost	Zone	Sian Otot	End Type
4	12305.59765630000	2	El Bosque	1
4	12312.15234380000	2	El Bosque	1
4	12140.41210940000	2	El Bosque	1
4	12018.54394530000	2	El Bosque	1
4	11650.40527340000	2	El Bosque	1
4	13230.32617190000	2	El Bosque	1
4	11216.08007810000	2	El Bosque	1
4	12998.96191410000	2	El Bosque	1
4	11542.57226560000	2	El Bosque	1
4	11203.61914060000	2	El Bosque	1
4	11382.30566410000	2	El Bosque	1
4	11017.83886720000	2	El Bosque	1
4	10978.71679690000	2	El Bosque	1
4	10976.27539060000	2	El Bosque	1
4	10858.26269530000	2	El Bosque	1
4	10722.53027340000	2	El Bosque	1
4	10689.74023440000	2	El Bosque	1
4	11429.90527340000	2	El Bosque	1
4	11589.03222660000	2	El Bosque	1
4	10447.46484380000	2	El Bosque	1
4	10271.75976560000	2	El Bosque	1
4	9951.60156250000	2	El Bosque	1
4	11377.07519530000	2	El Bosque	1
4	9813.82128906000	2	El Bosque	1
4	10512.35351560000	2	El Bosque	1
4	9942.02441406000	2	El Bosque	1
4	10157.33593750000	2	El Bosque	1
4	9696.72363281000	2	El Bosque	1
4	9707.03125000000	2	El Bosque	1
4	9725.62109375000	2	El Bosque	1
4	9571.96191406000	2	El Bosque	1
4	9613.61914063000	2	El Bosque	1
4	9355.85253906000	2	El Bosque	1
4	9099.34375000000	2	El Bosque	1
4	10043.65332030000	2	El Bosque	1
4	9382.97558594000	2	El Bosque	1
4	9050.34277344000	2	El Bosque	1
4	9312.66699219000	2	El Bosque	1
4	9241.83398438000	2	El Bosque	1
4	9124.72070313000	2	El Bosque	1
4	9156.26660156000	2	El Bosque	1
4	9287.00195313000	2	El Bosque	1
4	9186.91210938000	2	El Bosque	1
4	9062.02636719000	2	El Bosque	1
4	8979.62597656000	2	El Bosque	1
4	10813.00488280000	2	El Bosque	1
4	11022.25781250000	2	El Bosque	1
4	9328.48632813000	2	El Bosque	1

4	9110.27246094000	2	El Bosque	1
4	8798.26074219000	2	El Bosque	1
4	9011.60253906000	2	El Bosque	1
4	8979.08398438000	2	El Bosque	1
4	8665.30371094000	2	El Bosque	1
4	9030.97070313000	2	El Bosque	1
4	8963.59570313000	2	El Bosque	1
4	8415.35156250000	2	El Bosque	1
4	8262.87011719000	2	El Bosque	1
4	8074.63769531000	2	El Bosque	1
4	8100.80810547000	2	El Bosque	1
4	7900.52343750000	2	El Bosque	1
4	7750.81005859000	2	El Bosque	1
4	7448.08056641000	2	El Bosque	1
4	7283.80664063000	2	El Bosque	1
4	7173.04345703000	2	El Bosque	1
4	7059.23730469000	2	El Bosque	1
4	7129.62744141000	2	El Bosque	1
4	6961.94677734000	2	El Bosque	1
4	6985.11279297000	2	El Bosque	1
4	6804.17578125000	2	El Bosque	1
4	7473.94384766000	2	El Bosque	1
4	7088.99365234000	2	El Bosque	1
4	7012.08691406000	2	El Bosque	1
4	6511.94189453000	2	El Bosque	1
4	6616.92333984000	2	El Bosque	1
4	6662.63916016000	2	El Bosque	1
4	6557.18212891000	2	El Bosque	1
4	6147.35400391000	2	El Bosque	1
4	5847.72070313000	2	El Bosque	1
4	6024.31787109000	2	El Bosque	1
4	5891.94531250000	2	El Bosque	1
4	6127.23046875000	2	El Bosque	1
4	6201.68066406000	2	El Bosque	1
4	5574.97070313000	2	El Bosque	1
4	5973.18017578000	2	El Bosque	1
4	5489.18798828000	2	El Bosque	1
4	5943.80859375000	2	El Bosque	1
4	5530.75048828000	2	El Bosque	1
4	5433.49755859000	2	El Bosque	1
4	5691.72509766000	2	El Bosque	1
4	5506.69775391000	2	El Bosque	1
4	8645.45605469000	2	El Bosque	1
4	5053.42919922000	2	El Bosque	1
4	5164.85351563000	2	El Bosque	1
4	4953.65576172000	2	El Bosque	1
4	5115.87890625000	2	El Bosque	1
4	5452.04980469000	2	El Bosque	1
4	4751.00048828000	2	El Bosque	1
4	5197.14550781000	2	El Bosque	1
4	4839.93212891000	2	El Bosque	1

4	4801.00390625000	2	El Bosque	1
4	5142.21923828000	2	El Bosque	1
4	4575.13330078000	2	El Bosque	1
4	5984.51025391000	2	El Bosque	1
4	4598.90673828000	2	El Bosque	1
4	4703.83642578000	2	El Bosque	1
4	5503.60009766000	2	El Bosque	1
4	5768.00585938000	2	El Bosque	1
4	7892.46386719000	2	El Bosque	1
4	6740.28173828000	2	El Bosque	1
4	4709.25781250000	2	El Bosque	1
4	4450.10253906000	2	El Bosque	1
4	4714.35546875000	2	El Bosque	1
4	4399.05712891000	2	El Bosque	1
4	4633.14794922000	2	El Bosque	1
4	8341.95214844000	2	El Bosque	1
4	4661.78857422000	2	El Bosque	1
4	4701.42871094000	2	El Bosque	1
4	5108.06640625000	2	El Bosque	1
4	4422.86572266000	2	El Bosque	1
4	4277.99658203000	2	El Bosque	1
4	4546.75732422000	2	El Bosque	1
4	4346.89355469000	2	El Bosque	1
4	4432.48291016000	2	El Bosque	1
4	4123.48876953000	2	El Bosque	1
4	4258.77197266000	2	El Bosque	1
4	8056.25390625000	2	El Bosque	1
4	5509.84521484000	2	El Bosque	1
4	5348.11523438000	2	El Bosque	1
4	4310.95996094000	2	El Bosque	1
4	3996.24560547000	2	El Bosque	1
4	5013.20703125000	2	El Bosque	1
4	3851.12426758000	2	El Bosque	1
4	4235.26464844000	2	El Bosque	1
4	4124.91113281000	2	El Bosque	1
4	4039.54833984000	2	El Bosque	1
4	4002.99072266000	2	El Bosque	1
4	4246.13720703000	2	El Bosque	1
4	3972.60131836000	2	El Bosque	1
4	3802.09472656000	2	El Bosque	1
4	7009.07324219000	2	El Bosque	1
4	3610.47973633000	2	El Bosque	1
4	7135.50830078000	2	El Bosque	1
4	4733.64697266000	2	El Bosque	1
4	3469.67553711000	2	El Bosque	1
4	5037.24560547000	2	El Bosque	1
4	3529.74340820000	2	El Bosque	1
4	3271.34765625000	2	El Bosque	1
4	3474.43481445000	2	El Bosque	1
4	3467.50830078000	2	El Bosque	1
4	3553.49975586000	2	El Bosque	1

4	3460.99072266000	2	El Bosque	1
4	7206.80615234000	2	El Bosque	1
4	5974.58203125000	2	El Bosque	1
4	4180.03466797000	2	El Bosque	1
4	3332.19384766000	2	El Bosque	1
4	3337.57397461000	2	El Bosque	1
4	7271.46728516000	2	El Bosque	1
4	3108.07836914000	2	El Bosque	1
4	3013.06250000000	2	El Bosque	1
4	5370.41162109000	2	El Bosque	1
4	2923.70971680000	2	El Bosque	1
4	7006.77050781000	2	El Bosque	1
4	2998.61840820000	2	El Bosque	1
4	2999.16674805000	2	El Bosque	1
4	5180.01708984000	2	El Bosque	1
4	5923.85839844000	2	El Bosque	1
4	7735.21728516000	2	El Bosque	1
4	6393.09375000000	2	El Bosque	1
4	2761.03393555000	2	El Bosque	1
4	5077.57373047000	2	El Bosque	1
4	6084.89355469000	2	El Bosque	1
4	2873.45361328000	2	El Bosque	1
4	7781.59472656000	2	El Bosque	1
4	2567.50366211000	2	El Bosque	1
4	5478.16210938000	2	El Bosque	1
4	5250.52148438000	2	El Bosque	1
4	2519.73364258000	2	El Bosque	1
4	5827.26123047000	2	El Bosque	1
4	6770.35498047000	2	El Bosque	1
4	2435.56933594000	2	El Bosque	1
4	6126.12792969000	2	El Bosque	1
4	2527.47143555000	2	El Bosque	1
4	2814.60693359000	2	El Bosque	1
4	2660.89282227000	2	El Bosque	1
4	5688.03759766000	2	El Bosque	1
4	2726.97216797000	2	El Bosque	1
4	7885.69384766000	2	El Bosque	1
4	1994.37036133000	2	El Bosque	1
4	2246.56787109000	2	El Bosque	1
4	1913.90454102000	2	El Bosque	1
4	2125.36645508000	2	El Bosque	1
4	2019.17358398000	2	El Bosque	1
4	2429.08105469000	2	El Bosque	1
4	2126.87231445000	2	El Bosque	1
4	2224.25317383000	2	El Bosque	1
4	2055.25854492000	2	El Bosque	1
4	2086.19140625000	2	El Bosque	1
4	2092.09643555000	2	El Bosque	1
4	2314.53491211000	2	El Bosque	1
4	1820.62780762000	2	El Bosque	1
4	1938.58801270000	2	El Bosque	1

4	1914.20861816000	2	El Bosque	1
4	2323.25244141000	2	El Bosque	1
4	2209.23144531000	2	El Bosque	1
4	1607.19213867000	2	El Bosque	1
4	1928.36181641000	2	El Bosque	1
4	1539.32141113000	2	El Bosque	1
4	1617.02319336000	2	El Bosque	1
4	1628.91320801000	2	El Bosque	1
4	3077.81591797000	2	El Bosque	1
4	2196.31665039000	2	El Bosque	1
4	1642.65185547000	2	El Bosque	1
4	1446.00817871000	2	El Bosque	1
4	1608.58105469000	2	El Bosque	1
4	1673.80822754000	2	El Bosque	1
4	1467.84863281000	2	El Bosque	1
4	1630.78564453000	2	El Bosque	1
4	1989.36206055000	2	El Bosque	1
4	1254.53308105000	2	El Bosque	1
4	1208.20715332000	2	El Bosque	1
4	2143.65844727000	2	El Bosque	1
4	1187.18542480000	2	El Bosque	1
4	1360.56860352000	2	El Bosque	1
4	7486.08105469000	2	El Bosque	1
4	6766.17480469000	2	El Bosque	1
4	1439.34545898000	2	El Bosque	1
4	1497.46447754000	2	El Bosque	1
4	1585.49462891000	2	El Bosque	1
4	1545.14013672000	2	El Bosque	1
4	8394.88964844000	2	El Bosque	1
4	1265.74841309000	2	El Bosque	1
4	1462.65002441000	2	El Bosque	1
4	5556.33251953000	2	El Bosque	1
4	5706.54199219000	2	El Bosque	1
4	1177.34594727000	2	El Bosque	1
4	1634.82202148000	2	El Bosque	1
4	9043.12792969000	2	El Bosque	1
4	5354.57031250000	2	El Bosque	1
4	1653.54919434000	2	El Bosque	1
4	8686.46386719000	2	El Bosque	1
4	1117.92468262000	2	El Bosque	1
4	8031.75537109000	2	El Bosque	1
4	8283.03027344000	2	El Bosque	1
4	5481.89160156000	2	El Bosque	1
4	2175.01269531000	2	El Bosque	1
4	4898.40039063000	2	El Bosque	1
4	7729.01074219000	2	El Bosque	1
4	7978.67626953000	2	El Bosque	1
4	4965.17041016000	2	El Bosque	1
4	7703.51367188000	2	El Bosque	1
4	4515.96191406000	2	El Bosque	1
4	7750.08154297000	2	El Bosque	1

4	8945.16113281000	2	El Bosque	1
4	5619.44384766000	2	El Bosque	1
4	8055.02832031000	2	El Bosque	1
4	4898.72021484000	2	El Bosque	1
4	8424.83496094000	2	El Bosque	1
4	5150.98046875000	2	El Bosque	1
4	4775.60351563000	2	El Bosque	1
4	6536.19677734000	2	El Bosque	1
4	9103.37890625000	2	El Bosque	1
4	4076.44091797000	2	El Bosque	1
4	4393.82910156000	2	El Bosque	1
4	1725.09777832000	2	El Bosque	1
4	374.63931274400	2	El Bosque	1
4	4655.98974609000	2	El Bosque	1
4	9164.28417969000	2	El Bosque	1
4	8473.42773438000	2	El Bosque	1
4	8762.32324219000	2	El Bosque	1
4	3250.23950195000	2	El Bosque	1
4	6654.96923828000	2	El Bosque	1
4	4457.02050781000	2	El Bosque	1
4	1687.33361816000	2	El Bosque	1
4	718.16931152300	2	El Bosque	1
4	8086.29003906000	2	El Bosque	1
4	3611.97094727000	2	El Bosque	1
4	479.20764160200	2	El Bosque	1
4	6668.48779297000	2	El Bosque	1
4	3790.29321289000	2	El Bosque	1
4	1710.99743652000	2	El Bosque	1
4	3321.84057617000	2	El Bosque	1
4	3511.11889648000	2	El Bosque	1
4	405.56903076200	2	El Bosque	1
4	3620.53515625000	2	El Bosque	1
4	9208.84765625000	2	El Bosque	1
4	696.96234130900	2	El Bosque	1
4	8245.71972656000	2	El Bosque	1
4	3928.01440430000	2	El Bosque	1
4	9407.13769531000	2	El Bosque	1
4	4524.64648438000	2	El Bosque	1
4	540.40869140600	2	El Bosque	1
4	3664.34472656000	2	El Bosque	1
4	8032.55126953000	2	El Bosque	1
4	792.50518798800	2	El Bosque	1
4	4299.87109375000	2	El Bosque	1
4	8403.05468750000	2	El Bosque	1
4	9257.59960938000	2	El Bosque	1
4	671.89904785200	2	El Bosque	1
4	6856.93603516000	2	El Bosque	1
4	729.61987304700	2	El Bosque	1
4	561.75787353500	2	El Bosque	1
4	3850.03002930000	2	El Bosque	1
4	5845.41259766000	2	El Bosque	1

4	5339.60791016000	2	El Bosque	1
4	587.80645752000	2	El Bosque	1
4	879.47888183600	2	El Bosque	1
4	1133.26904297000	2	El Bosque	1
4	9125.36230469000	2	El Bosque	1
4	1842.92077637000	2	El Bosque	1
4	6695.59814453000	2	El Bosque	1
4	741.38751220700	2	El Bosque	1
4	4732.29443359000	2	El Bosque	1
4	823.82177734400	2	El Bosque	1
4	792.16296386700	2	El Bosque	1
4	3597.56469727000	2	El Bosque	1
4	4505.11035156000	2	El Bosque	1
4	1439.32214355000	2	El Bosque	1
4	3869.08544922000	2	El Bosque	1
4	8198.75585938000	2	El Bosque	1
4	3739.89672852000	2	El Bosque	1
4	691.13787841800	2	El Bosque	1
4	5402.53955078000	2	El Bosque	1
4	887.15771484400	2	El Bosque	1
4	1926.97534180000	2	El Bosque	1
4	931.78277587900	2	El Bosque	1
4	3363.73974609000	2	El Bosque	1
4	2992.39331055000	2	El Bosque	1
4	823.06213378900	2	El Bosque	1
4	3761.60180664000	2	El Bosque	1
4	911.77282714800	2	El Bosque	1
4	1804.45288086000	2	El Bosque	1
4	974.75866699200	2	El Bosque	1
4	1683.81298828000	2	El Bosque	1
4	941.91485595700	2	El Bosque	1
4	5217.69335938000	2	El Bosque	1
4	9498.15429688000	2	El Bosque	1
4	1464.79028320000	2	El Bosque	1
4	1075.06579590000	2	El Bosque	1
4	3935.77441406000	2	El Bosque	1
4	4282.13769531000	2	El Bosque	1
4	9570.06054688000	2	El Bosque	1
4	1205.55383301000	2	El Bosque	1
4	1448.32043457000	2	El Bosque	1
4	1099.36560059000	2	El Bosque	1
4	1121.22473145000	2	El Bosque	1
4	1414.99316406000	2	El Bosque	1
4	1504.92333984000	2	El Bosque	1
4	1720.12109375000	2	El Bosque	1
4	6587.44384766000	2	El Bosque	1
4	4095.77368164000	2	El Bosque	1
4	3411.16113281000	2	El Bosque	1
4	4183.82763672000	2	El Bosque	1
4	6822.57763672000	2	El Bosque	1
4	1865.96679688000	2	El Bosque	1

4	4563.85693359000	2	El Bosque	1
4	1744.57067871000	2	El Bosque	1
4	7218.26074219000	2	El Bosque	1
4	1323.54138184000	2	El Bosque	1
4	8715.52148438000	2	El Bosque	1
4	1311.61694336000	2	El Bosque	1
4	8184.22363281000	2	El Bosque	1
4	1483.65380859000	2	El Bosque	1
4	3367.91772461000	2	El Bosque	1
4	3885.47167969000	2	El Bosque	1
4	10143.66308590000	2	El Bosque	1
4	9904.40332031000	2	El Bosque	1
4	3763.74072266000	2	El Bosque	1
4	3220.27880859000	2	El Bosque	1
4	8911.06152344000	2	El Bosque	1
4	6549.71191406000	2	El Bosque	1
4	5981.71240234000	2	El Bosque	1
4	6531.40234375000	2	El Bosque	1
4	9857.08203125000	2	El Bosque	1
4	5697.46191406000	2	El Bosque	1
4	6631.22314453000	2	El Bosque	1
4	4703.48144531000	2	El Bosque	1
4	5832.79101563000	2	El Bosque	1
4	3644.14453125000	2	El Bosque	1
4	3628.39208984000	2	El Bosque	1
4	2817.22656250000	2	El Bosque	1
4	2937.99707031000	2	El Bosque	1
4	9946.62792969000	2	El Bosque	1
4	6424.67187500000	2	El Bosque	1
4	3657.20043945000	2	El Bosque	1
4	3475.06542969000	2	El Bosque	1
4	6932.05371094000	2	El Bosque	1
4	4890.99804688000	2	El Bosque	1
4	8172.66308594000	2	El Bosque	1
4	5419.00683594000	2	El Bosque	1
4	3128.16284180000	2	El Bosque	1
4	5916.68750000000	2	El Bosque	1
4	3587.86254883000	2	El Bosque	1
4	8419.05371094000	2	El Bosque	1
4	11620.61718750000	2	El Bosque	1
4	3032.54736328000	2	El Bosque	1
4	10215.94824220000	2	El Bosque	1
4	8373.78515625000	2	El Bosque	1
4	11661.95898440000	2	El Bosque	1
4	11303.37207030000	2	El Bosque	1
4	10786.75976560000	2	El Bosque	1
4	5751.28515625000	2	El Bosque	1
4	7586.22314453000	2	El Bosque	1
4	4298.81298828000	2	El Bosque	1
4	4026.56542969000	2	El Bosque	1
4	8113.18164063000	2	El Bosque	1

4	8214.82910156000	2	El Bosque	1
4	11362.19921880000	2	El Bosque	1
4	8329.08886719000	2	El Bosque	1
4	8746.58593750000	2	El Bosque	1
4	8350.19140625000	2	El Bosque	1
4	8513.42675781000	2	El Bosque	1
4	8985.36621094000	2	El Bosque	1
4	9283.45019531000	2	El Bosque	1
4	9337.55078125000	2	El Bosque	1
4	9130.36816406000	2	El Bosque	1
4	9209.89941406000	2	El Bosque	1
4	9141.45507813000	2	El Bosque	1
4	9672.89843750000	2	El Bosque	1
4	9772.67675781000	2	El Bosque	1
4	9897.99609375000	2	El Bosque	1
4	10181.32324220000	2	El Bosque	1
4	10392.91015630000	2	El Bosque	1
4	11075.95703130000	2	El Bosque	1
4	11453.38085940000	2	El Bosque	1
4	10893.91503910000	2	El Bosque	1
4	11609.76855470000	2	El Bosque	1
4	11134.46484380000	2	El Bosque	1
4	11782.43847660000	2	El Bosque	1
4	12185.91992190000	2	El Bosque	1
4	12200.85253910000	2	El Bosque	1
4	12707.33203130000	2	El Bosque	1
4	13076.79296880000	2	El Bosque	1
4	13478.23144530000	2	El Bosque	1
4	12838.85839840000	2	El Bosque	1
4	12305.75781250000	2	El Bosque	1
4	13505.23046880000	2	El Bosque	1
4	13254.07031250000	2	El Bosque	1
4	13259.73437500000	2	El Bosque	1
4	12437.45898440000	2	El Bosque	1
4	14717.93164060000	2	El Bosque	1
4	11647.09960940000	2	El Bosque	2
4	11332.85253910000	2	El Bosque	2
4	11029.11718750000	2	El Bosque	2
4	11132.27441410000	2	El Bosque	2
4	9219.09765625000	2	El Bosque	2
4	9294.45019531000	2	El Bosque	2
4	9199.09375000000	2	El Bosque	2
4	8999.12792969000	2	El Bosque	2
4	8802.77832031000	2	El Bosque	2
4	8498.17871094000	2	El Bosque	2
4	8935.60156250000	2	El Bosque	2
4	8143.32568359000	2	El Bosque	2
4	8554.84472656000	2	El Bosque	2
4	7439.69335938000	2	El Bosque	2
4	7128.32031250000	2	El Bosque	2
4	7193.75781250000	2	El Bosque	2

4	5930.27050781000	2	El Bosque	2
4	6111.58447266000	2	El Bosque	2
4	5827.44677734000	2	El Bosque	2
4	5368.04150391000	2	El Bosque	2
4	5003.86669922000	2	El Bosque	2
4	4676.11572266000	2	El Bosque	2
4	5175.37890625000	2	El Bosque	2
4	4938.33789063000	2	El Bosque	2
4	4898.93457031000	2	El Bosque	2
4	4733.67822266000	2	El Bosque	2
4	4406.47753906000	2	El Bosque	2
4	4627.40966797000	2	El Bosque	2
4	4474.11425781000	2	El Bosque	2
4	3726.79809570000	2	El Bosque	2
4	3909.92822266000	2	El Bosque	2
4	4883.32177734000	2	El Bosque	2
4	3857.99511719000	2	El Bosque	2
4	3569.09790039000	2	El Bosque	2
4	3507.52392578000	2	El Bosque	2
4	3200.76391602000	2	El Bosque	2
4	7630.17187500000	2	El Bosque	2
4	2965.34350586000	2	El Bosque	2
4	3049.66918945000	2	El Bosque	2
4	2776.83300781000	2	El Bosque	2
4	5689.66650391000	2	El Bosque	2
4	2817.09692383000	2	El Bosque	2
4	2642.46435547000	2	El Bosque	2
4	2582.74145508000	2	El Bosque	2
4	2373.07348633000	2	El Bosque	2
4	2190.55371094000	2	El Bosque	2
4	2089.77709961000	2	El Bosque	2
4	2121.13647461000	2	El Bosque	2
4	2133.84667969000	2	El Bosque	2
4	2435.80493164000	2	El Bosque	2
4	2431.81494141000	2	El Bosque	2
4	1950.74108887000	2	El Bosque	2
4	2317.37939453000	2	El Bosque	2
4	2430.07592773000	2	El Bosque	2
4	1815.90649414000	2	El Bosque	2
4	1673.79772949000	2	El Bosque	2
4	2214.75805664000	2	El Bosque	2
4	7246.16943359000	2	El Bosque	2
4	1818.07324219000	2	El Bosque	2
4	1511.44677734000	2	El Bosque	2
4	2094.96142578000	2	El Bosque	2
4	1460.19946289000	2	El Bosque	2
4	6602.81298828000	2	El Bosque	2
4	1443.47778320000	2	El Bosque	2
4	2306.06152344000	2	El Bosque	2
4	1464.46105957000	2	El Bosque	2
4	1224.50268555000	2	El Bosque	2

4	2287.02832031000	2	El Bosque	2
4	8562.58007813000	2	El Bosque	2
4	939.36993408200	2	El Bosque	2
4	1426.58886719000	2	El Bosque	2
4	1159.00964355000	2	El Bosque	2
4	5642.49365234000	2	El Bosque	2
4	1746.86706543000	2	El Bosque	2
4	7487.82861328000	2	El Bosque	2
4	440.73632812500	2	El Bosque	2
4	355.44116210900	2	El Bosque	2
4	1362.73693848000	2	El Bosque	2
4	7638.71728516000	2	El Bosque	2
4	466.01147460900	2	El Bosque	2
4	2003.56298828000	2	El Bosque	2
4	732.46942138700	2	El Bosque	2
4	523.42840576200	2	El Bosque	2
4	3201.05981445000	2	El Bosque	2
4	5155.79199219000	2	El Bosque	2
4	1070.36376953000	2	El Bosque	2
4	927.20080566400	2	El Bosque	2
4	776.16455078100	2	El Bosque	2
4	745.84179687500	2	El Bosque	2
4	1380.85559082000	2	El Bosque	2
4	805.36413574200	2	El Bosque	2
4	1285.57141113000	2	El Bosque	2
4	973.03723144500	2	El Bosque	2
4	632.17395019500	2	El Bosque	2
4	3334.14868164000	2	El Bosque	2
4	1251.07336426000	2	El Bosque	2
4	919.69488525400	2	El Bosque	2
4	1147.56323242000	2	El Bosque	2
4	1175.79809570000	2	El Bosque	2
4	1239.75000000000	2	El Bosque	2
4	3961.95068359000	2	El Bosque	2
4	10151.35058590000	2	El Bosque	2
4	4048.31762695000	2	El Bosque	2
4	2444.36083984000	2	El Bosque	2
4	9102.02539063000	2	El Bosque	2
4	4376.27246094000	2	El Bosque	2
4	7828.44433594000	2	El Bosque	2
4	7811.83251953000	2	El Bosque	2
4	8005.24169922000	2	El Bosque	2
4	8266.94921875000	2	El Bosque	2
4	8847.81347656000	2	El Bosque	3
4	8144.17041016000	2	El Bosque	3
4	5510.64794922000	2	El Bosque	3
4	5241.03466797000	2	El Bosque	3
4	3758.49072266000	2	El Bosque	3
4	2528.31958008000	2	El Bosque	3
4	2979.49853516000	2	El Bosque	3
4	2333.54443359000	2	El Bosque	3

4	2526.76953125000	2	El Bosque	3
4	2618.12133789000	2	El Bosque	3
4	2169.67431641000	2	El Bosque	3
4	2323.36767578000	2	El Bosque	3
4	1997.61437988000	2	El Bosque	3
4	1562.12255859000	2	El Bosque	3
4	7832.00927734000	2	El Bosque	3
4	1807.41296387000	2	El Bosque	3
4	1817.17602539000	2	El Bosque	3
4	606.80169677700	2	El Bosque	3
4	1696.46484375000	2	El Bosque	3
4	699.30426025400	2	El Bosque	3
4	8212.83691406000	2	El Bosque	3
4	1460.55297852000	2	El Bosque	3
4	1497.01599121000	2	El Bosque	3
4	6914.22460938000	2	El Bosque	3
4	9392.09179688000	2	El Bosque	3
4	3446.17968750000	2	El Bosque	4
4	3258.10693359000	2	El Bosque	4
4	3000.56811523000	2	El Bosque	4
4	1878.31347656000	2	El Bosque	4
4	1489.48168945000	2	El Bosque	4
4	1998.93103027000	2	El Bosque	4
4	2407.07080078000	2	El Bosque	4
4	1393.72314453000	2	El Bosque	4
4	8308.40429688000	2	El Bosque	4
4	987.74560546900	2	El Bosque	4
4	1320.72644043000	2	El Bosque	4
4	3223.84936523000	2	El Bosque	4
4	469.30636596700	2	El Bosque	4
4	241.54214477500	2	El Bosque	4
4	920.66271972700	2	El Bosque	4

Appendix E: List of Sample Structures and Sites in Visibility Analysis

	Site	Site Type	Zone	Urban/Hinterland	*Sian Otot*
1	Structure 10L-4	5	2	Urban	Principal Group
2	Structure 10L-11	5	2	Urban	Principal Group
3	Structure 10L-16	5	2	Urban	Principal Group
4	Structure 10L-18	5	2	Urban	Principal Group
5	Structure 10L-21	5	2	Urban	Principal Group
6	Structure 10L-22	5	2	Urban	Principal Group
7	Structure 10L-26	5	2	Urban	Principal Group
8	Group 10L-2	5	2	Urban	Principal Group
9	Group 11L-17	1	2	Urban	El Bosque
10	Group 10J-1	1	2	Urban	El Bosque
11	Group 11L-3	2	2	Urban	El Bosque
12	Group 11L-13	3	2	Urban	El Bosque
13	Group 10J-6	3	2	Urban	El Bosque
14	Group 11K-6	4	2	Urban	El Bosque
15	Group 10L-18	4	2	Urban	El Bosque
16	Group 9M-15	1	2	Urban	Las Sepulturas
17	Group 9M-9	2	2	Urban	Las Sepulturas
18	Group 9M-16	3	2	Urban	Las Sepulturas
19	Group 9N-8	4	2	Urban	Las Sepulturas
20	Group 8L-1	1	3	Urban	Salamar
21	Group 8L-4	2	3	Urban	Salamar
22	Group 9L-8	2	3	Urban	Salamar
23	Group 8L-10	3	3	Urban	Salamar
24	Group 8L-12	4	3	Urban	Salamar
25	Group 9K-16	1	3	Urban	Comedero
26	Group 9J-4	2	3	Urban	Comedero
27	Group 9J-5	4	3	Urban	Comedero
28	Group 7M-8	2	3	Urban	Chorro
29	Group 7M-16	3	3	Urban	Chorro
30	Group 6N-6	1	3	Hinterland	Rastrojon
31	Group 7N-13	1	3	Hinterland	Rastrojon
32	Group 7N-4	2	3	Hinterland	Rastrojon
33	Group 6N-1	2	3	Hinterland	Rastrojon
34	Group 6N-2	2	3	Hinterland	Rastrojon
35	Group 7M-4	3	3	Hinterland	Rastrojon
36	Group 5P-4	1	3	Hinterland	Mesa de Petapilla
37	Group 5O-7	2	3	Hinterland	Mesa de Petapilla
38	Group 5O-8	3	3	Hinterland	Mesa de Petapilla
39	Group 5O-1	3	3	Hinterland	Mesa de Petapilla
40	Group 3O-3	1	3	Hinterland	Bolsa de Petapilla
41	Group 3O-8	2	3	Hinterland	Bolsa de Petapilla
42	Group 4Q-2	1	3	Hinterland	Titoror
43	Group 4Q-3	1	3	Hinterland	Titoror
44	Group 10H-4	1	3	Hinterland	El Pueblo

45	Group 10H-2	2	3	Hinterland	El Pueblo
46	Group 9I-1	4	3	Hinterland	El Pueblo
47	Group 7O-4	1	4	Hinterland	Titichon
48	Group 8O-2	2	4	Hinterland	Titichon
49	Group 9P-5	2	4	Hinterland	Titichon
50	Group 9P-1	2	4	Hinterland	Titichon
51	Group 10O-4	1	4	Hinterland	San Rafael
52	Group 10P-4	2	4	Hinterland	San Rafael
53	Group 11N-4	1	4	Hinterland	San Lucas
54	Group 12M-1	1	4	Hinterland	San Lucas
55	Group 11M-10	2	4	Hinterland	San Lucas
56	Group 12K-1	1	4	Hinterland	El Puente
57	Group 12L-1	2	4	Hinterland	El Puente
58	Group 12G-5	1	5	Hinterland	Algodonal
59	Group 12F-3	3	5	Hinterland	Algodonal
60	Group 14E-4	1	5	Hinterland	Estanzuela
61	Group 13F-1	2	5	Hinterland	Estanzuela
62	Group 14F-1	3	5	Hinterland	Estanzuela
63	Group 15C-2	1	5	Hinterland	Tapescos
64	Group 15D-3	1	5	Hinterland	Tapescos
65	Group 12D-5	1	5	Hinterland	Rincon del Buey
66	Group 12D-6	2	5	Hinterland	Rincon del Buey
67	Group 10E-4	1	5	Hinterland	Ostuman
68	Group 10F-2	1	5	Hinterland	Ostuman
69	Group 10F-1	3	5	Hinterland	Ostuman
70	Group 11E-2	3	5	Hinterland	Ostuman
71	Group 10E-6	4	5	Hinterland	Ostuman
72	Group 9H-3	1	5	Hinterland	Yaragua
73	Group 9G-5	2	5	Hinterland	Yaragua
74	Group 3N-2	1	3	Hinterland	Quebrada Seca
75	Group 3M-1	2	3	Hinterland	Quebrada Seca

Appendix F: Visibility Data Tables

Due to the large number and size of data tables, the appendix includes a sample data table (source site is Group 11L-13, El Bosque) and not all of the original visibility tables. The table lists all sites at Copán, their site type (1−4), and whether the sites were visible from the source site. The data from these tables were used to calculate visibility values and then imported into Minitab 15 to test for statistical significance.

* Visible Sites = 1
* Non-Visible Sites = 0

Source Site: Group 11L-13 (Type 3), El Bosque

Sites	Site Type	Visible or Non-Visible
11M-12	1	1
11K-15	1	1
11K-10	1	1
9K-2	1	1
9K-16	1	1
11K-5	1	1
11M-1	1	1
11M-4	1	1
10P-3	1	1
11K-9	1	1
11O-1	1	1
10P-2	1	1
11N-4	1	1
12J-5	1	1
10P-9	1	1
12G-4	1	1
9K-9	1	1
11M-9	1	1
11J-1	1	1
11L-4	1	1
9K-3	1	1
9L-4	1	1
10P-8	1	1
11I-1	1	1
11J-2	1	1
11L-18	1	1
11P-3	1	1
9L-11	1	1
11K-17	1	1
12E-1	1	1
9K-15	1	1
11K-21	1	1
11K-8	1	1

11L-5	1	1
12K-1	1	1
12M-3	1	1
10P-5	1	1
11K-11	1	1
11M-8	1	1
12H-4	1	1
8L-5	1	1
9P-3	1	1
10P-10	1	1
11J-4	1	1
11O-2	1	1
12F-1	1	1
9J-3	1	1
9K-6	1	1
9P-4	1	1
11L-23	1	1
12H-1	1	1
12P-2	1	1
6M-1	1	1
8P-12	1	1
9J-1	1	1
9K-17	1	1
10P-7	1	1
11L-16	1	1
11L-2	1	1
11N-5	1	1
7M-18	1	1
7M-19	1	1
11N-3	1	1
11O-3	1	1
12G-3	1	1
12J-3	1	1
7L-1	1	1
7L-5	1	1
9J-4	1	1
9K-10	1	1
9L-3	1	1
10P-1	1	1
11J-5	1	1
11K-12	1	1
11K-16	1	1
11K-4	1	1
11L-11	1	1
11M-7	1	1
12G-6	1	1
17L-2	1	1
9J-6	1	1
9L-1	1	1

12G-2	1	1
12J-2	1	1
8L-7	1	1
12G-5	1	1
12H-3	1	1
12K-3	1	1
10P-6	1	1
11L-14	1	1
11N-6	1	1
7M-12	1	1
7M-17	1	1
11J-3	1	1
12F-2	1	1
12G-1	1	1
12J-1	1	1
12J-4	1	1
11K-7	1	1
12G-7	1	1
9L-7	1	1
11M-6	1	1
11P-1	1	1
12K-2	1	1
10G-1	1	1
10H-3	1	1
10I-1	1	1
10I-2	1	1
10J-1	1	1
10J-10	1	1
10J-11	1	1
10J-2	1	1
10J-5	1	1
10J-9	1	1
10J_9	1	1
10K-11	1	1
10K-12	1	1
10K-14	1	1
10K-2	1	1
10K-4	1	1
10K-9	1	1
10L-10	1	1
10L-11	1	1
10L-13	1	1
10L-14	1	1
10L-15	1	1
10L-7	1	1
10L-9	1	1
10M-4	1	1
10M-5	1	1
10M-7	1	1

10N-1	1	1
10N-10	1	1
10N-3	1	1
10N-6	1	1
10N-8	1	1
10N-9	1	1
10O-1	1	1
10O-10	1	1
10O-2	1	1
10O-3	1	1
10O-4	1	1
10O-5	1	1
10O-6	1	1
10O-8	1	1
11I-2	1	1
11N-2	1	1
10E-10	1	0
10E-2	1	0
10E-3	1	0
10E-4	1	0
10E-5	1	0
10E-7	1	0
10E-8	1	0
10E-9	1	0
10F-2	1	0
10F-4	1	0
10F-5	1	0
10H-1	1	0
10H-4	1	0
10H-5	1	0
10J-7	1	0
10K-13	1	0
10M-6	1	0
10N-2	1	0
10N-4	1	0
10N-5	1	0
10N-7	1	0
10O-9	1	0
11D-1	1	0
11D-2	1	0
11D-3	1	0
11D-4	1	0
11D-5	1	0
11D-6	1	0
11D-7	1	0
11E-1	1	0
11E-3	1	0
11E-4	1	0
11E-5	1	0

11K-18	1	0
11K-19	1	0
11K-2	1	0
11K-20	1	0
11K-22	1	0
11K-3	1	0
11M-3	1	0
11N-1	1	0
11P-2	1	0
11P-4	1	0
11P-5	1	0
12C-1	1	0
12C-2	1	0
12D-1	1	0
12D-2	1	0
12D-3	1	0
12D-4	1	0
12D-5	1	0
12F-6	1	0
12H-2	1	0
12H-5	1	0
12M-2	1	0
13C-1	1	0
13C-2	1	0
13C-3	1	0
13C-4	1	0
13F-10	1	0
13F-3	1	0
13F-5	1	0
13F-6	1	0
13F-7	1	0
13F-8	1	0
13F-9	1	0
14D-1	1	0
14D-2	1	0
14D-3	1	0
14E-1	1	0
14E-2	1	0
14E-3	1	0
14E-4	1	0
14E-5	1	0
14E-6	1	0
14E-7	1	0
14E-8	1	0
14F-2	1	0
14F-3	1	0
14F-4	1	0
14F-5	1	0
15C-1	1	0

15C-2	1	0
15C-3	1	0
15C-4	1	0
15C-5	1	0
15C-6	1	0
15C-7	1	0
15D-1	1	0
15D-2	1	0
15D-3	1	0
15D-4	1	0
15D-5	1	0
16C-1	1	0
18P-11	1	0
3M-3	1	0
3N-1	1	0
3N-2	1	0
3O-1	1	0
3O-2	1	0
3O-3	1	0
3O-4	1	0
3O-5	1	0
3O-6	1	0
3O-7	1	0
3P-1	1	0
3P-2	1	0
3R-1	1	0
3R-2	1	0
4N-1	1	0
4N-2	1	0
4N-3	1	0
4N-4	1	0
4N-5	1	0
4O-1	1	0
4O-11	1	0
4O-12	1	0
4O-13	1	0
4O-14	1	0
4O-2	1	0
4O-3	1	0
4O-4	1	0
4O-5	1	0
4O-6	1	0
4O-7	1	0
4O-8	1	0
4O-9	1	0
4P-1	1	0
4P-2	1	0
4P-4	1	0
4P-5	1	0

4P-6	1	0
4Q-1	1	0
4Q-2	1	0
4Q-3	1	0
4Q-4	1	0
4Q-5	1	0
4Q-6	1	0
4Q-7	1	0
4Q-8	1	0
5M-1	1	0
5N-1	1	0
5N-3	1	0
5N-4	1	0
5N-5	1	0
5N-6	1	0
5N-7	1	0
5O-11	1	0
5O-12	1	0
5O-2	1	0
5O-3	1	0
5O-4	1	0
5O-5	1	0
5O-9	1	0
5P-1	1	0
5P-3	1	0
5P-4	1	0
6N-10	1	0
6N-11	1	0
6N-12	1	0
6N-13	1	0
6N-3	1	0
6N-4	1	0
6N-5	1	0
6N-6	1	0
6N-7	1	0
6N-8	1	0
6N-9	1	0
6O-1	1	0
6O-2	1	0
7K-2	1	0
7K-3	1	0
7L-4	1	0
7M-1	1	0
7M-11	1	0
7M-3	1	0
7M-5	1	0
7M-7	1	0
7M-9	1	0
7N-1	1	0

7N-10	1	0
7N-11	1	0
7N-13	1	0
7N-14	1	0
7N-15	1	0
7N-16	1	0
7N-17	1	0
7N-18	1	0
7N-19	1	0
7N-2	1	0
7N-3	1	0
7N-5	1	0
7N-6	1	0
7N-7	1	0
7N-8	1	0
7N-9	1	0
7O-1	1	0
7O-10	1	0
7O-3	1	0
7O-4	1	0
7O-5	1	0
7O-6	1	0
7O-7	1	0
7O-8	1	0
7O-9	1	0
7P-1	1	0
7P-2	1	0
7P-3	1	0
7P-4	1	0
8K-1	1	0
8K-2	1	0
8K-3	1	0
8K-4	1	0
8K-5	1	0
8K-6	1	0
8L-1	1	0
8L-11	1	0
8L-13	1	0
8L-15	1	0
8L-17	1	0
8L-2	1	0
8M-1	1	0
8M-10	1	0
8M-2	1	0
8M-3	1	0
8M-4	1	0
8M-6	1	0
8M-7	1	0
8M-9	1	0

8N-1	1	0
8N-12	1	0
8N-2	1	0
8N-3	1	0
8N-5	1	0
8N-6	1	0
8N-7	1	0
8N-8	1	0
8N-9	1	0
8O-1	1	0
8O-3	1	0
8O-4	1	0
8O-5	1	0
8O-6	1	0
8O-7	1	0
8O-8	1	0
8P-10	1	0
8P-5	1	0
8P-6	1	0
8P-7	1	0
8P-8	1	0
9G-1	1	0
9G-2	1	0
9G-3	1	0
9G-4	1	0
9G-6	1	0
9H-1	1	0
9H-2	1	0
9H-3	1	0
9H-4	1	0
9H-5	1	0
9I-2	1	0
9K-4	1	0
9L-10	1	0
9L-12	1	0
9L-13	1	0
9L-14	1	0
9L-15	1	0
9L-17	1	0
9L-18	1	0
9L-19	1	0
9L-20	1	0
9L-21	1	0
9M-11	1	0
9M-12	1	0
9M-14	1	0
9M-15	1	0
9M-2	1	0
9M-20	1	0

9M-21	1	0
9M-23	1	0
9M-24	1	0
9M-26	1	0
9M-28	1	0
9M-29	1	0
9M-30	1	0
9M-31	1	0
9M-6	1	0
9M-7	1	0
9M-8	1	0
9N-1	1	0
9N-5	1	0
9O-1	1	0
9O-2	1	0
9P-2	1	0
11M-2	2	1
10H-2	2	1
10J-12	2	1
10K-1	2	1
10K-10	2	1
10K-15	2	1
10K-3	2	1
10K-6	2	1
10L-12	2	1
10L-17	2	1
10L-3	2	1
10L-4	2	1
10L-8	2	1
10M-3	2	1
10O-7	2	1
10P-3	2	1
10P-4	2	1
11K-1	2	1
11K-13	2	1
11K-14	2	1
11L-1	2	1
11L-10	2	1
11L-15	2	1
11L-3	2	1
11L-6	2	1
11L-7	2	1
11L-72	2	1
11L-8	2	1
11M-10	2	1
11M-11	2	1
12L-1	2	1
7L-3	2	1
7L-6	2	1

7M-13	2	1
7M-14	2	1
7M-15	2	1
8L-4	2	1
8L-6	2	1
8L-8	2	1
9J-2	2	1
9J-3	2	1
9J-4	2	1
9K-1	2	1
9K-11	2	1
9K-13	2	1
9K-14	2	1
9K-5	2	1
9K-7	2	1
9K-8	2	1
9L-2	2	1
9L-5	2	1
9L-6	2	1
9L-8	2	1
9P-1	2	1
9P-5	2	1
10-2	2	0
10E-1	2	0
10F-3	2	0
10K-8	2	0
10L-19	2	0
10M-2	2	0
12D-6	2	0
12E-2	2	0
12F-5	2	0
12M-1	2	0
13F-1	2	0
13F-2	2	0
13F-4	2	0
3M-1	2	0
3M-2	2	0
3O-8	2	0
3P-3	2	0
4O-10	2	0
4P-3	2	0
4P-7	2	0
5N-2	2	0
5O-10	2	0
5O-6	2	0
5O-7	2	0
5P-2	2	0
5P-5	2	0
6N-1	2	0

6N-2	2	0
7K-1	2	0
7M-10	2	0
7M-2	2	0
7M-8	2	0
7N-12	2	0
7N-20	2	0
7N-4	2	0
7O-2	2	0
8L-14	2	0
8L-16	2	0
8L-3	2	0
8L-9	2	0
8M-5	2	0
8M-8	2	0
8N-10	2	0
8N-4	2	0
8O-2	2	0
8P-9	2	0
9G-5	2	0
9L-16	2	0
9L-9	2	0
9M-10	2	0
9M-13	2	0
9M-17	2	0
9M-25	2	0
9M-27	2	0
9M-4	2	0
9M-5	2	0
9M-9	2	0
9N-27	2	0
9N-7	2	0
11L-13	3	1
12F-3	3	1
7M-16	3	1
8L-10	3	1
10J-6	3	1
11L-12	3	1
9K-4	3	1
10L-5	3	1
10L-6	3	1
10J-8	3	1
10F-1	3	0
11E-2	3	0
14F-1	3	0
5O-1	3	0
5O-8	3	0
7M-4	3	0
9L-22	3	0

9M-1	3	0
9M-16	3	0
9M-18	3	0
9M-22	3	0
9M-3	3	0
9N-2	3	0
9N-4	3	0
9N-6	3	0
10L-18	4	1
11K-6	4	1
9J-5	4	1
10L-16	4	1
10K-7	4	1
10K-5	4	1
8L-12	4	1
10E-6	4	0
10L-20	4	0
10M-1	4	0
8N-11	4	0
9I-1	4	0
9L-23	4	0
9L-23	4	0
9M-19	4	0
9N-8	4	0

Appendix G: Integration Tables and Summary Descriptions for *Sian Otots*

Pattern A

The Kruskal-Wallis tests indicate that fourteen of Copán's residential *sian otots* had the following access pattern: Type 4–Type 3–Type 2–Type 1. Sites types are listed in order from most to least accessible. Pattern A reflects an access hierarchy that replicates Copán's social hierarchy in which the elite living at type 4 sites were more accessible than the elite at type 3 sites, and commoners living at type 2 sites were more accessible than commoners living at type 1 sites, but less accessible than the elite.

Las Sepulturas

Las Sepulturas borders the eastern side of the Principal Group and has all four residential site types (1-4). This sub-community has some of the lowest integration values in the valley suggesting that its residents were well integrated with society as a whole. Although the integration values in Table G.1 show that it was less costly for people living in this sub-community to travel to type 4 sites, the Mann-Whitney results indicate no significant differences for the integration values of type 3 and type 4 sites (Table G.2).

Site Type	N (paths)	Integration Value
1	1762	4755
2	438	3161
3	99	2544
4	62	**2159**
Great Plaza	54	1547
Acropolis	52	2584
Royal Courtyard	50	2203
p-value = <0.0001		

Table G.1: Kruskal-Wallis Test—access results for sites in Las Sepulturas

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]Y	[1]Y	[1]Y	[1]Y	[1]Y	[1]Y
Type 2			[2]Y	[1]Y	[1]Y	[1]Y	[1]Y
Type 3				N	[3]Y	N	N
Type 4					[4]Y	[5]Y	N
Great Plaza						[1]Y	[1]Y
Acropolis							[1]Y
Royal Courtyard							
Significance level: [1]< 0.0001 [2]0.0017 [3]0. 0008 [4]0.0006 [5]0.0035							

Table G.2: Mann-Whitney Test—access results for sites in Las Sepulturas

Salamar

Salamar borders the Principal Group to the northeast and has all four residential site types (1-4). Although the integration values in Table G.3 exhibit Pattern A, the Mann-Whitney results in Table G.4 indicate no significant differences for the integration values of type 2 and type 3 sites or for type 3 and type 4 sites.

Site Type	N (paths)	Integration Value
1	1750	4916
2	436	2967
3	98	2397
4	60	**2377**
Great Plaza	57	1998
Acropolis	56	2889
Royal Courtyard	57	2832
p-value = <0.0001		

Table G.3: Kruskal-Wallis Test—access results for sites in Salamar

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]Y	[1]Y	[1]Y	[1]Y	[1]Y	[1]Y
Type 2			N	[2]Y	[1]Y	N	N
Type 3				N	[3]Y	N	N
Type 4					[4]Y	[5]Y	[6]Y
Great Plaza						[1]Y	[1]Y
Acropolis							N
Royal Courtyard							
Significance level: [1]< 0.0001 [2]0.0017 [3]0. 0050 [4]0.0181 [5]0.0014 [6]0.0004							

Table G.4: Mann-Whitney Test—access results for sites in Salamar

Comedero

Comedero borders the Principal Group to the northwest and consists of site types 1, 2, and 4. Similar to Las Sepulturas, Comedero has low integration values indicating that sub-community members had a high degree of access to other Copanecos. Although the integration values in Table G.5 suggest that it was less costly for people living in Comedero to travel to type 3 sites than to type 2 sites, the Mann-Whitney results in Table G.6 indicate that the travel costs between these two site types were not significantly different.

Site Type	N (paths)	Integration Value
1	1317	5663
2	329	3490
3	75	3238
4	45	**2105**
Great Plaza	21	1461
Acropolis	21	2380
Royal Courtyard	22	2648
p-value = <0.0001		

Table G.5: Kruskal-Wallis Test—access results for sites in Comedero

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]**Y**	[1]**Y**	[1]**Y**	[1]**Y**	[1]**Y**	[1]**Y**
Type 2			**N**	[1]**Y**	[1]**Y**	[2]**Y**	**N**
Type 3				[1]**Y**	[1]**Y**	[3]**Y**	[4]**Y**
Type 4					[5]**Y**	**N**	[6]**Y**
Great Plaza						[1]**Y**	[1]**Y**
Acropolis							[7]**Y**
Royal Courtyard							
Significance level: [1]<0.0001	[2]0.0081	[3]0.0006	[4]0.0337	[5]0.0096	[6]0.0049	[7]0.0156	

Table G.6: Mann-Whitney Test—access results for sites in Comedero

El Bosque

El Bosque borders the Principal Group to the south and west and has all four site types (1-4). Although the integration values for El Bosque are somewhat lower than for Comedero, both sub-communities have similar access patterns. Despite the fact that the integration values in Table G.7 suggest that it was less costly for people living in El Bosque to travel to type 3 sites than to type 2 sites, the Mann-Whitney results in Table G.8 indicate that the travel costs between these two site types were not significantly different.

Site Type	N (paths)	Integration Value
1	1764	6562
2	435	4338
3	100	3928
4	62	**3345**
Great Plaza	87	2008
Acropolis	87	2500
Royal Courtyard	84	2011
p-value = <0.0001		

Table G.7: Kruskal-Wallis Test—access results for sites in El Bosque

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]Y	[1]Y	[1]Y	[1]Y	[1]Y	[1]Y
Type 2			N	[1]Y	[1]Y	[1]Y	[1]Y
Type 3				[2]Y	[1]Y	[1]Y	[1]Y
Type 4					[1]Y	[3]Y	[1]Y
Great Plaza						[1]Y	N
Acropolis							[4]Y
Royal Courtyard							
Significance level: [1]<0.0001 [2]0.0004 [3]0.0002 [4]0.0001							

Table G.8: Mann-Whitney Test—access results for sites in El Bosque

El Pueblo

El Pueblo is about 1.25 km west-northwest of the Principal Group and consists of type 1 and type 2 sites and two type 4 sites. Archaeological excavations suggest that this area was the valley's original seat of power before it shifted to the Principal Group (Fash 1983a). El Pueblo's access patterns replicate the valley-wide access hierarchy (Table G.9), yet similar to Comedero and El Bosque, its eastern and southeastern neighbors, respectively, the integration values for type 2 and type 3 sites are not significantly different (Table G.10).

Site Type	N (paths)	Integration Value
1	1321	7159
2	329	6003
3	75	5604
4	47	**4286**
Great Plaza	12	4653
Acropolis	12	5489
Royal Courtyard	12	6394
p-value = <0.0001		

Table G.9: Kruskal-Wallis Test—access results for sites in El Pueblo

	Type 1	**Type 2**	**Type 3**	**Type 4**	**Great Plaza**	**Acropolis**	**Royal Courtyard**
Type 1		[1]**Y**	[2]**Y**	[3]**Y**	[4]**Y**	[5]**Y**	**N**
Type 2			**N**	[3]**Y**	[6]**Y**	**N**	**N**
Type 3				[7]**Y**	[8]**Y**	**N**	**N**
Type 4					**N**	**N**	**Y**
Great Plaza						[9]**Y**	[10]**Y**
Acropolis							[11]**Y**
Royal Courtyard							

Significance level: [1]0.0003 [2]0.0002 [3]<0.0001 [4]0.0014 [5]0.0297 [6]0.0050 [7]0.0015 [8]0.0197 [9]0.0404 [10]0.0009 [11]0.0102

Table G.10: Mann-Whitney Test—access results for sites in El Pueblo

El Puente

El Puente is south of the river in the central part of the valley and consists of type 1 and type 2 sites. El Puente's integration values, albeit slighter higher than many urban core *sian otots,* are still comparatively low suggesting that despite the absence of any elite sites, its residents were nevertheless relatively well integrated with society as a whole (Table G.11). Table G.12 indicates that there are no significant differences between type 2 and type 3 sites.

Site Type	N (paths)	Integration Value
1	886	7357
2	219	5508
3	50	5207
4	30	**4346**
Great Plaza	10	3876
Acropolis	10	4093
Royal Courtyard	10	4529
p-value = <0.0001		

Table G.11: Kruskal-Wallis Test—access results for sites in El Puente

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]**Y**	[2]**Y**	[1]**Y**	[3]**Y**	[4]**Y**	[5]**Y**
Type 2			**N**	[6]**Y**	[7]**Y**	[8]**Y**	[9]**Y**
Type 3				[10]**Y**	[11]**Y**	[12]**Y**	**N**
Type 4					**N**	**N**	**N**
Great Plaza						**N**	**N**
Acropolis							**N**
Royal Courtyard							
Significance level: [1]<0.0001 [2]0.0022 [3]0.0003 [4]0.0010 [5]0.0020 [6]0.0004 [7]0.0073 [8]0.0203 [9]0.0448 [10]0.0014 [11]0.0037 [12]0.0128							

Table G.12: Mann-Whitney Test—access results for sites in El Puente

Yaragua

Yaragua is in the northwest part of the Copán Valley and consists of type 1 and type 2 sites. Although the integration values in Table G.13 exhibit Pattern A, the Mann-Whitney results in Table G.14 indicate that there are not significant differences between type 2 and type 3 sites.

Site Type	N (paths)	Integration Value
1	877	8089
2	219	6999
3	50	6951
4	32	**5616**
Great Plaza	11	6112
Acropolis	11	7043
Royal Courtyard	11	7448
p-value = <0.0001		

Table G.13: Kruskal-Wallis Test—access results for sites in Yaragua

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]**Y**	[2]**Y**	[3]**Y**	[4]**Y**	**N**	**N**
Type 2			**N**	[5]**Y**	[6]**Y**	**N**	**N**
Type 3				[7]**Y**	[8]**Y**	**N**	**N**
Type 4					**N**	[9]**Y**	[10]**Y**
Great Plaza						[11]**Y**	[5]**Y**
Acropolis							[12]**Y**
Royal Courtyard							
Significance level: [1]0.0258 [2]0.0058 [3]<0.0001 [4]0.0218 [5]0.0001 [6]0.0354 [7]0.0083 [8]0.0437 [9]0.0118 [10]0.0008 [11]0.0006 [12]0.0256							

Table G.14: Mann-Whitney Test—access results for sites in Yaragua

San Lucas

San Lucas is south of the Río Copán in the southeast part of the valley and like all southeastern sub-communities, it consists of only type 1 and type 2 sites. Despite the fact that the area does not have any elite sites and is outside the urban core in an area of low settlement density, its integration values indicate that its residents were relatively well integrated with society as a whole (Table G.15). Table G.16 shows a lack of significant differences between type 2 and type 3 sites and between type 3 and type 4 sites.

Site Type	N (paths)	Integration Value
1	1325	5987
2	330	4532
3	75	3892
4	48	**3513**
Great Plaza	22	2706
Acropolis	22	2803
Royal Courtyard	22	2131
p-value = <0.0001		

Table G.15: Kruskal-Wallis Test—access results for sites in San Lucas

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		**[1]Y**	**[2]Y**	**[1]Y**	**[1]Y**	**[1]Y**	**[1]Y**
Type 2			**N**	**[3]Y**	**[1]Y**	**[1]Y**	**[1]Y**
Type 3				**N**	**[1]Y**	**[1]Y**	**[1]Y**
Type 4					**[4]Y**	**[5]Y**	**[1]Y**
Great Plaza						**N**	**[6]Y**
Acropolis							**[7]Y**
Royal Courtyard							
Significance level: [1]<0.0001 [2]0.0001 [3]0.0041 [4]0.0002 [5]0.0007 [6]0.0032 [7]0.0012 [8]0.0							

Table G.16: Mann-Whitney Test—access results for sites in San Lucas

San Rafael

San Rafael is south of the Río Copán in the southeast part of the valley and has only type 1 and type 2 sites. Table G.17 shows that despite its similarities to San Lucas, its southwestern neighbor, San Rafael's residents were less integrated with society as a whole. The results in Table G.18 indicate that while the integration values for type 1 sites were significantly different from all other site types, there were no significant differences among the integration values of type 2, type 3, and type 4 sites, suggesting that the residents of San Rafael were not intentionally channeled to specific site types and thus, their movement through the landscape seems to have been less controlled than movement in other sub-communities that exhibit Pattern A.

Site Type	N (paths)	Integration Value
1	1316	6431
2	329	5774
3	75	5371
4	47	**5309**
Great Plaza	44	3693
Acropolis	44	4339
Royal Courtyard	44	3590
p-value = <0.0001		

Table G.17: Kruskal-Wallis Test—access results for sites in San Rafael

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		**[1]Y**	**[2]Y**	**[3]Y**	**[4]Y**	**[4]Y**	**[4]Y**
Type 2			**N**	**N**	**[4]Y**	**[4]Y**	**[4]Y**
Type 3				**N**	**[4]Y**	**[5]Y**	**[4]Y**
Type 4					**[4]Y**	**[6]Y**	**[4]Y**
Great Plaza						**[7]Y**	**N**
Acropolis							**[8]Y**
Royal Courtyard							
Significance level: [1]0.0005 [2]0.0187 [3]0.0038 [4]<0.0001 [5]0.0016 [6]0.0012 [7]0.0058 [8]0.0034							

Table G.18: Mann-Whitney Test—access results for sites in San Rafael

Ostuman

Ostuman is the only sub-community in far western part of the valley with a type 4 site. The presence of a type 4 site and two type 3 sites in Ostuman reflects greater wealth than found in other western sub-communities, which archaeologists believe results from the sub-community's longer occupational history (Fash 1983a). Although the sub-community's integration values are higher than those for eastern sub-communities exhibiting Pattern A, they are the lowest in the western part of the valley (Table G.19), suggesting that Ostuman's residents found it less costly to interact with people from other parts of the city than people living in other western sub-communities. Thus, it is likely that its residents interacted with a greater number of people on a more routine basis.

The presence of several elite sites along with its relatively low integration values (lower travel costs) suggests that Ostuman may have been a local (intermediate-level) seat of power to which inhabitants of nearby sub-communities traveled to settle disputes, attend ritual events, and deal with intermediate-level problems and needs.

In marked contrast to many eastern sub-communities, the Mann-Whitney results in Table G.20 indicate that there are no significant differences between type 1 and type 2 sites, but there are significant differences in access between the other site types, suggesting that sociopolitical organization in western sub-communities was different from eastern sub-communities.

Site Type	N (paths)	Integration Value
1	2201	10772
2	550	10346
3	124	9742
4	79	**8743**
Great Plaza	26	9543
Acropolis	26	10473
Royal Courtyard	26	10401
p-value = <0.0001		

Table G.19: Kruskal-Wallis Test--access results for sites in Ostuman

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		N	[1]Y	[2]Y	N	N	N
Type 2			[3]Y	[2]Y	N	N	N
Type 3				[4]Y	N	N	N
Type 4					[5]Y	[2]Y	[2]Y
Great Plaza						[6]Y	[7]Y
Acropolis							N
Royal Courtyard							
Significance level: [1]0.0098 [2]<0.0001 [3]0.0114 [4]0.0092 [5]0.0487 [6]0.0018 [7]0.0003							

Table G.20: Mann-Whitney Test—access results for sites in Ostuman

Algodonal

Algodonal is in the western half of the valley and consists of several type 1 sites and one type 3 site. Although the valley-wide access hierarchy is replicated (Table G.21), the lack of significant differences between many site types suggests that the channeling of movement to certain site types was minimal (Table G.22).

Site Type	N (paths)	Integration Value
1	884	10329
2	220	9897
3	49	9475
4	32	**8490**
Great Plaza	16	8048
Acropolis	16	8979
Royal Courtyard	16	9344
p-value = 0.008		

Table G.21: Kruskal-Wallis Test—access results for sites in Algodonal

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		N	N	[1]Y	[2]Y	N	N
Type 2			N	[3]Y	[4]Y	N	N
Type 3				N	[5]Y	N	N
Type 4					N	N	N
Great Plaza						[6]Y	[7]Y
Acropolis							N
Royal Courtyard							
Significance level: [1]0.0122	[2]0.0388	[3]0.0010	[4]0.0012	[5]0.0194	[6]0.0275	[7]0.0011	

Table G.22: Mann-Whitney Test—access results for sites in Algodonal

Estanzuela

Estanzuela is south of the Río Copán in the western part of the valley. Most of its residents live at type 1 and type 2 sites, but the sub-community also has one type 3 site, which boasts a single large pyramid-like structure. It has the largest and most complex site in the southwestern part of the valley and its integration values are lower in comparison to its western neighbors, Rincon del Buey and Tapescos (Table G.23). Perhaps Estanzuela was a southern counterpart to Ostuman, functioning as another intermediate-level seat of power. The Mann-Whitney results in Table G.24 indicate a lack of significant differences between most site types suggests that the channeling of movement to certain site types was minimal.

Site Type	N (paths)	Integration Value
1	1328	11709
2	328	11273
3	75	10836
4	48	**9906**
Great Plaza	24	10605
Acropolis	25	11530
Royal Courtyard	25	11764
p-value = 0.017		

Table G.23: Kruskal-Wallis Test—access results for sites in Estanzuela

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		N	N	[1]Y	N	N	N
Type 2			[2]Y	[3]Y	N	N	N
Type 3				N	N	N	N
Type 4					N	[4]Y	[5]Y
Great Plaza						N	[6]Y
Acropolis							N
Royal Courtyard							
Significance level: [1]0.0067 [2]0.0396 [3]0.0001 [4]0.0002 [5]0.0006 [6]0.0026							

Table G.24: Mann-Whitney Test—access results for sites in Estanzuela

Rincon del Buey

Rincon del Buey is at the western edge of the Copán Valley and consists of type 1 and type 2 sites. The sub-community has some of the highest integration values in the valley indicating that its residents were somewhat segregated from society as a whole (Table G.25). This segregation is due to the fact that not only was costly for Rincon del Buey's residents to travel to other sites in other parts of the valley, but it was also costly for people from other areas to visit them. These high values suggest that the area was not a bustling thoroughfare with many people coming and going. The Mann-Whitney results in Table G.26 indicate a lack of significant differences in the integration values between most site types, suggesting that the channeling of movement to certain site types was minimal.

Site Type	N (paths)	Integration Value
1	1328	14227
2	328	13817
3	75	13290
4	48	**12049**
Great Plaza	24	12115
Acropolis	5	13043
Royal Courtyard	25	13358
p-value = 0.011		

Table G.25: Kruskal-Wallis Test—access results for sites in Rincon del Buey

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		**N**	**N**	[1]**Y**	**N**	**N**	**N**
Type 2			**N**	[2]**Y**	[3]**Y**	**N**	**N**
Type 3				**N**	[4]**Y**	**N**	**N**
Type 4					**N**	**N**	**N**
Great Plaza						[5]**Y**	[6]**Y**
Acropolis							**N**
Royal Courtyard							
Significance level: [1]0.0098 [2]0.0003 [3]0.0040 [4]0.0189 [5]0.0 010 [6]0.0002							

Table G.26: Mann-Whitney Test—access results for sites in Rincon del Buey

Tapescos

Tapescos is in the far southwest corner of the valley and all of its residents lived at type 1 sites. Its integration values are the highest in the valley suggesting that its residents were the most marginalized (Table G.27). Similar to other western sub-communities, the Mann-Whitney results in Table G.28 indicate that most site types lack significant differences in integration values.

Site Type	N (paths)	Integration Value
1	882	15698
2	220	15301
3	50	14993
4	32	**13300**
Great Plaza	16	13656
Acropolis	15	14268
Royal Courtyard	15	13700
p-value = 0.002		

Table G.27: Kruskal-Wallis Test—access results for sites in Tapescos

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		**N**	**N**	**[1]Y**	**N**	**N**	**[2]Y**
Type 2			**N**	**[3]Y**	**[4]Y**	**N**	**[5]Y**
Type 3				**N**	**[6]Y**	**N**	**[7]Y**
Type 4					**N**	**N**	**N**
Great Plaza						**[8]Y**	**N**
Acropolis							**[9]Y**
Royal Courtyard							
Significance level:	[1]0.0237	[2]0.0207	[3]0.0009	[4]0.0013	[5]0.0022	[6]0.0184	[7]0.0161
	[8]0.0003	[10]0.0128					

Table G.28: Mann-Whitney Test—access results for sites in Tapescos

Pattern B

Three of Copán's residential *sian otots* exhibited the following integration pattern: Type 3–Type 4–Type 2–Type 1 (listed in order from most to least accessible). This pattern differs from the valley-wide access pattern because type 3 rather than type 4 sites are the most accessible site type, highlighting spatial variation that only becomes evident at smaller scales of analysis. All three sub-communities are in the eastern part of the valley, two north of the Río Copán and one south of it.

Chorro

Chorro is northeast of Las Sepulturas, about one-kilometer from the Principal Group and consists of site types 1−3. The low integration values in Table G.29 indicate that the residents of Chorro were relatively well integrated with other Copanecos. The Mann-Whitney results in Table G.30 indicate that only type 1 sites (and some of the Principal Group areas) have significantly different integration values.

Site Type	N (paths)	Integration Value
1	1307	4750
2	330	3907
3	75	**3044**
4	47	3458
Great Plaza	18	2793
Acropolis	18	3622
Royal Courtyard	18	3646
p-value = <0.0001		

Table G.29: Kruskal-Wallis Test—access results for sites in Chorro

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]**Y**	[1]**Y**	[2]**Y**	[3]**Y**	[4]**Y**	[5]**Y**
Type 2			**N**	**N**	[6]**Y**	**N**	**N**
Type 3				**N**	**N**	**N**	**N**
Type 4					[7]**Y**	**N**	**N**
Great Plaza						[1]**Y**	[1]**Y**
Acropolis							**N**
Royal Courtyard							
Significance level: [1]< 0.0001 [2]0.0002 [3]0. 0001 [4]0.0066 [5]0.0075 [6]0.0276 [7]0.0329							

Table G.30: Mann-Whitney Test—access results for sites in Chorro

Rastrojon

Rastrojon is in the northeast part of the valley and consists of site types 1–3. The Kruskal-Wallis test indicates that sub-community residents were relatively well-integrated with society (Table G.31). Its Mann-Whitney results (Table G.32) indicate that like its southern neighbor, Chorro, only type 1 sites had sites (and some of the Principal Group areas) have significantly different integration values.

Site Type	N (paths)	Integration Value
1	1308	4956
2	328	4278
3	75	**3717**
4	47	4151
Great Plaza	54	3842
Acropolis	56	4885
Royal Courtyard	55	5158
p-value = <0.0001		

Table G.31: Kruskal-Wallis Test—access results for sites in Rastrojon

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]**Y**	[2]**Y**	[3]**Y**	[4]**Y**	**N**	**N**
Type 2			**N**	**N**	**N**	[5]**Y**	[2]**Y**
Type 3				**N**	**N**	[6]**Y**	[1]**Y**
Type 4					**N**	[7]**Y**	[8]**Y**
Great Plaza						[1]**Y**	[1]**Y**
Acropolis							**N**
Royal Courtyard							
Significance level: [1]< 0.0001 [2]0.0002 [3]0. 0253 [4]0.0008 [5]0.0010 [6]0.0001 [7]0.0048 [8]0.0025							

Table G.32: Mann-Whitney Test—access results for sites in Rastrojon

Titichon

The sub-community of Titichon is south of the river in the eastern part of the valley and consists of type 1 and type 2 sites. The Kruskal-Wallis test suggests that sub-community residents had differential access to most site types (Table G.33). The Mann-Whitney results in Table G.34 shows a lack of significant differences only between type 2 and type 4 sites and type 3 and type 4 sites, suggesting a relatively moderate degree of channeling of movement to certain site types.

Site Type	N (paths)	Integration Value
1	1310	5412
2	329	4978
3	75	**4270**
4	47	4550
Great Plaza	32	4182
Acropolis	32	5186
Royal Courtyard	32	4785
p-value = <0.0001		

Table G.33: Kruskal-Wallis Test—access results for sites in Titichon

	Type 1	Type	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		[1]Y	[2]Y	[3]Y	[4]Y	N	[5]Y
Type 2			[6]Y	N	[7]Y	N	N
Type 3				N	N	[8]Y	N
Type 4					N	[9]Y	N
Great Plaza						[10]Y	[11]Y
Acropolis							[12]Y
Royal Courtyard							
Significance level: [1]0.0001 [2]0.0006 [3]0.0090 [4]0.0003 [5]0.0359 [6]0.0351 [7]0.0028 [8]0.0024 [9]0.0098 [10]<0.0001 [11]0.0154 [12]0.0127							

Table G.34: Mann-Whitney Test—access results for sites in Titichon

Pattern C

Three of Copán's residential *sian otots* exhibited the following integration pattern: Type 3–Type 2–Type 4–Type 1 (listed in order from most to least accessible). This pattern is similar to Pattern B except that type 2 sites are more accessible than type 4 sites. The order of these sites is unique because it is the only place in the valley where commoner sites, i.e. type 2 sites, are more accessible than, at least, some elite sites. The three sub-communities are in the far eastern corner of the Copán Valley.

Mesa de Petapilla

Mesa de Petapilla is in the northeast part of valley and has several type 1 and 2 sites and two type 3 sites. Despite the sub-community's far northeastern location, Table G.35 indicates that its integration values are almost two times lower than the integration values for some far western sub-communities, supporting the conclusion that people who lived in the eastern part of the valley were more integrated with society than people who lived in the western part of the valley. The Mann-Whitney results in Table G.36 indicate that while significant differences do not exist between type 2 and type 3 sites, they do exist between type 3 and type 4 sites, indicating greater similarities between some elite and commoner sites (type 2 and type 3) than between elite sites (type 3 and type 4).

Site Type	N (paths)	Integration Value
1	1734	7795
2	439	7418
3	99	**6518**
4	64	7652
Great Plaza	40	7042
Acropolis	42	8075
Royal Courtyard	42	7794
p-value = 0.007		

Table G.35: Kruskal-Wallis Test—access results for sites in Mesa de Petapilla

	Type 1	Type 2	Type 3	Type 4	Great Plaza	Acropolis	Royal Courtyard
Type 1		**[1]Y**	**N**	**N**	**N**	**N**	**N**
Type 2			**N**	**[2]Y**	**N**	**[3]Y**	**[4]Y**
Type 3				**[5]Y**	**N**	**[6]Y**	**[7]Y**
Type 4					**[8]Y**	**[9]Y**	**N**
Great Plaza						**[10]Y**	**[10]Y**
Acropolis							**N**
Royal Courtyard							
Significance level: [1]0.0015 [2]0.0345 [3]0.0007 [4]0.0250 [5]0.0099 [6]0.0004 [7]0.0068 [8]0.0169 [9]0.0045 [10]<0.0001							

Table G.36: Mann-Whitney Test—access results for sites in Mesa de Petapilla

Bolsa de Petapilla

Bolsa de Petapilla is in the northeast part of valley and consists of a few widely-dispersed type 1 and 2 sites. The Kruskal-Wallis test indicates that there are no significant differences in the integration values between any site types in this sub-community (Table G.37). The lack of significant differentiation in the integration values suggests that the residents of Bolsa de Petapilla were not channeled toward any particular site type and thus, experienced less social segregation between social groups and sociopolitical control than people living in many other parts of the valley.

Site Type	N (paths)	Integration Value
1	1301	9279
2	328	8872
3	75	**8097**
4	48	9241
Great Plaza	19	8461
Acropolis	17	9474
Royal Courtyard	17	9289
p-value = 0.120		

Table G.37: Kruskal-Wallis Test—access results for sites in Bolsa de Petapilla

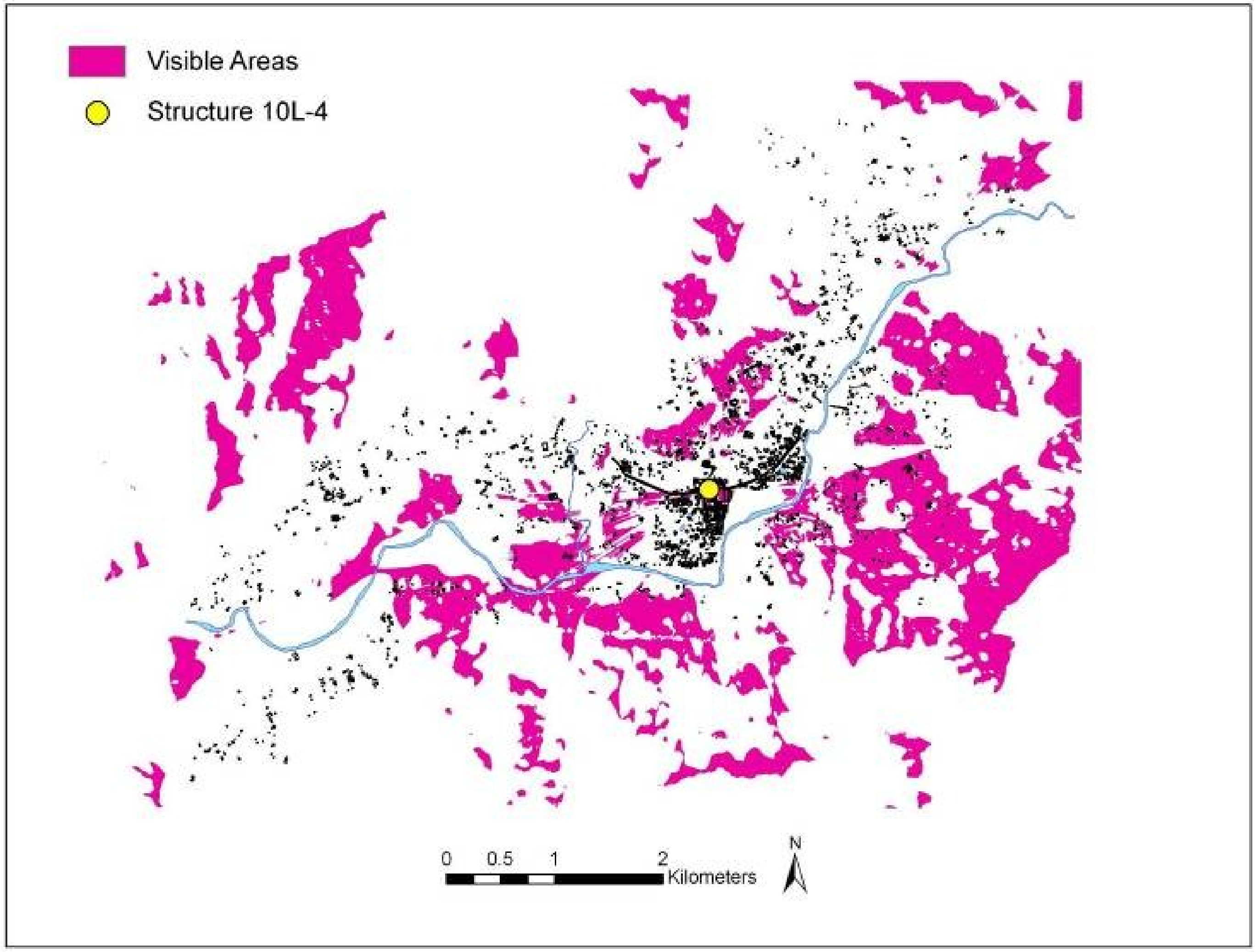
Titoror

Titoror is at the far northeast margins of the valley and only consists of type 1 sites. It has no significant differences in integration values (Table G.38). The lack of significant differentiation in the integration values suggests that the residents of Titotor, like its western neighbor, Bolsa de Petapilla, were not channeled toward any particular site type and thus, experienced less social segregation between social groups and sociopolitical control than people living in many other parts of the valley.

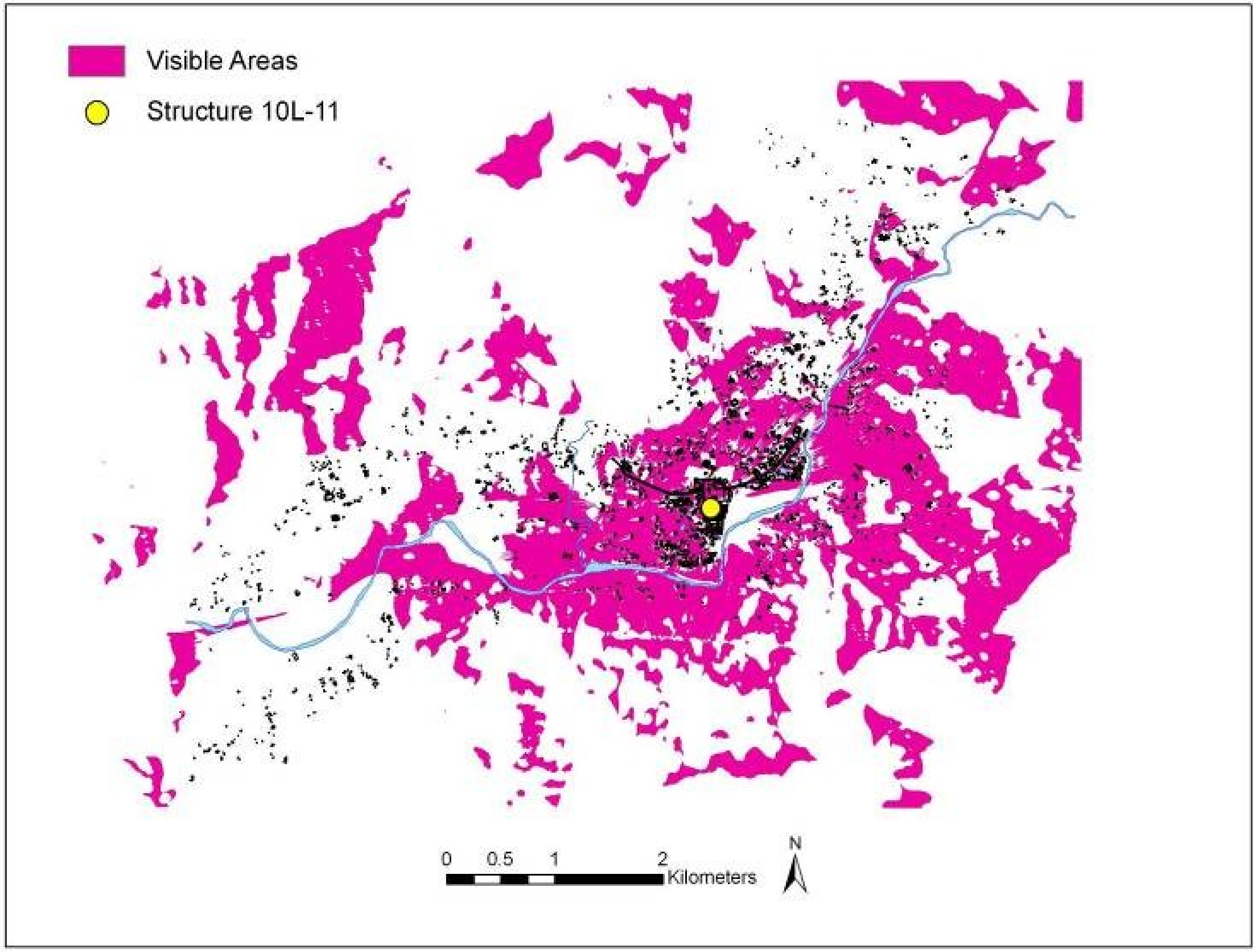
Site Type	N (paths)	Integration Value
1	436	10445
2	110	10146
3	25	**9520**
4	16	10316
Great Plaza	5	9608
Acropolis	7	10511
Royal Courtyard	7	9718
p-value =0.315		

Table G.38: Kruskal-Wallis Test—access results for sites in Titoror

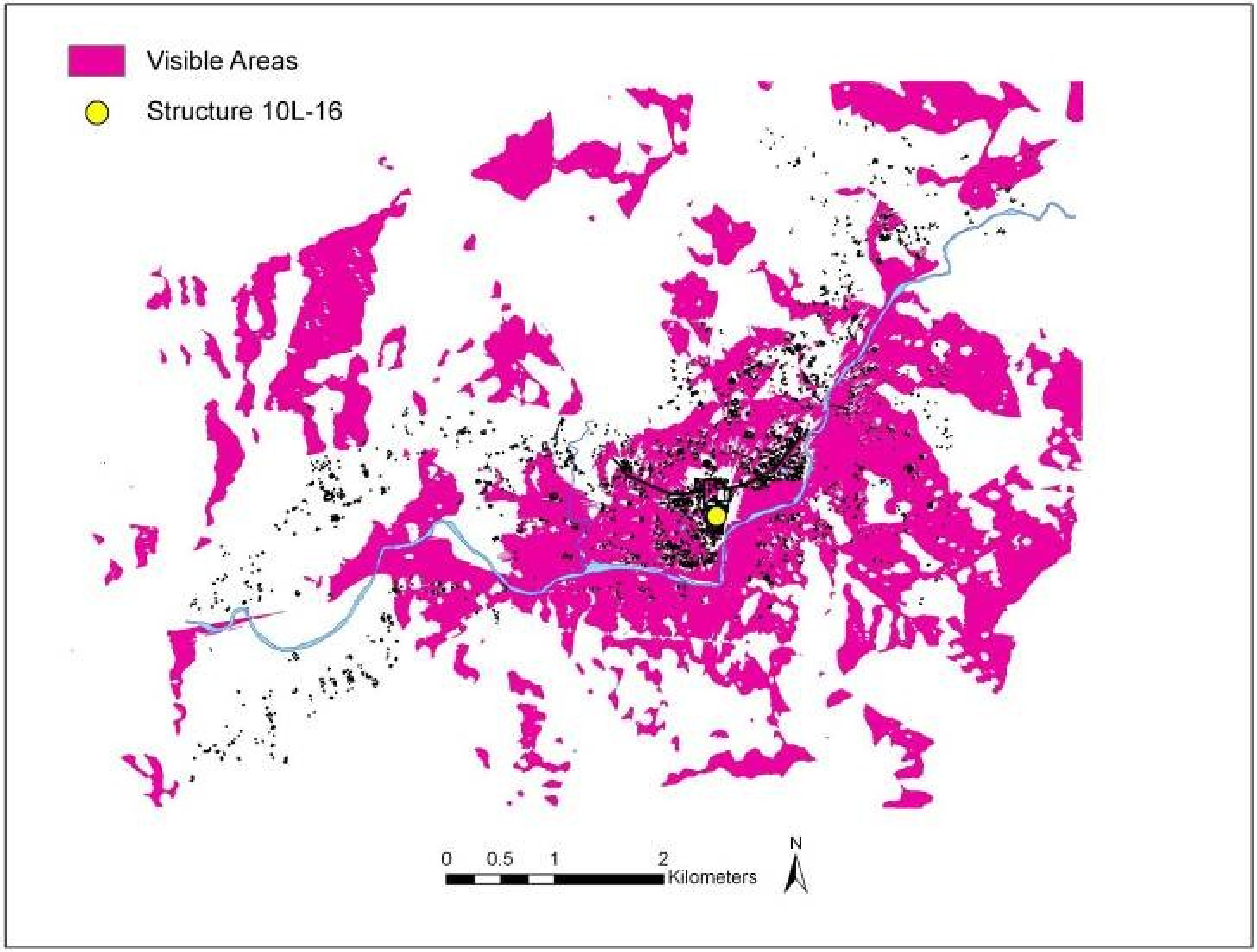
Appendix H: Viewsheds of Sample Sites



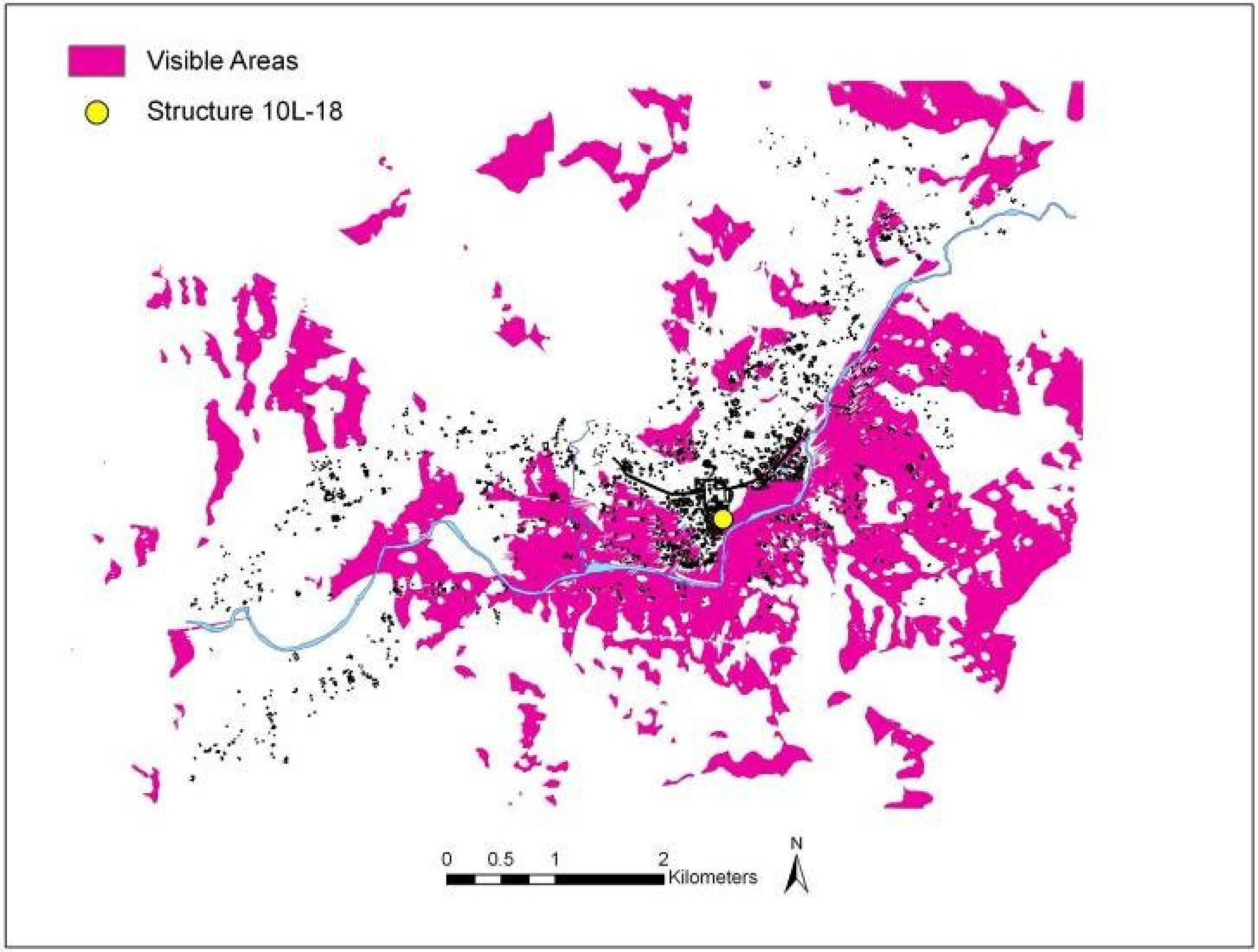
Map H.1: Viewshed of Structure 10L-4, Great Plaza, Principal Group



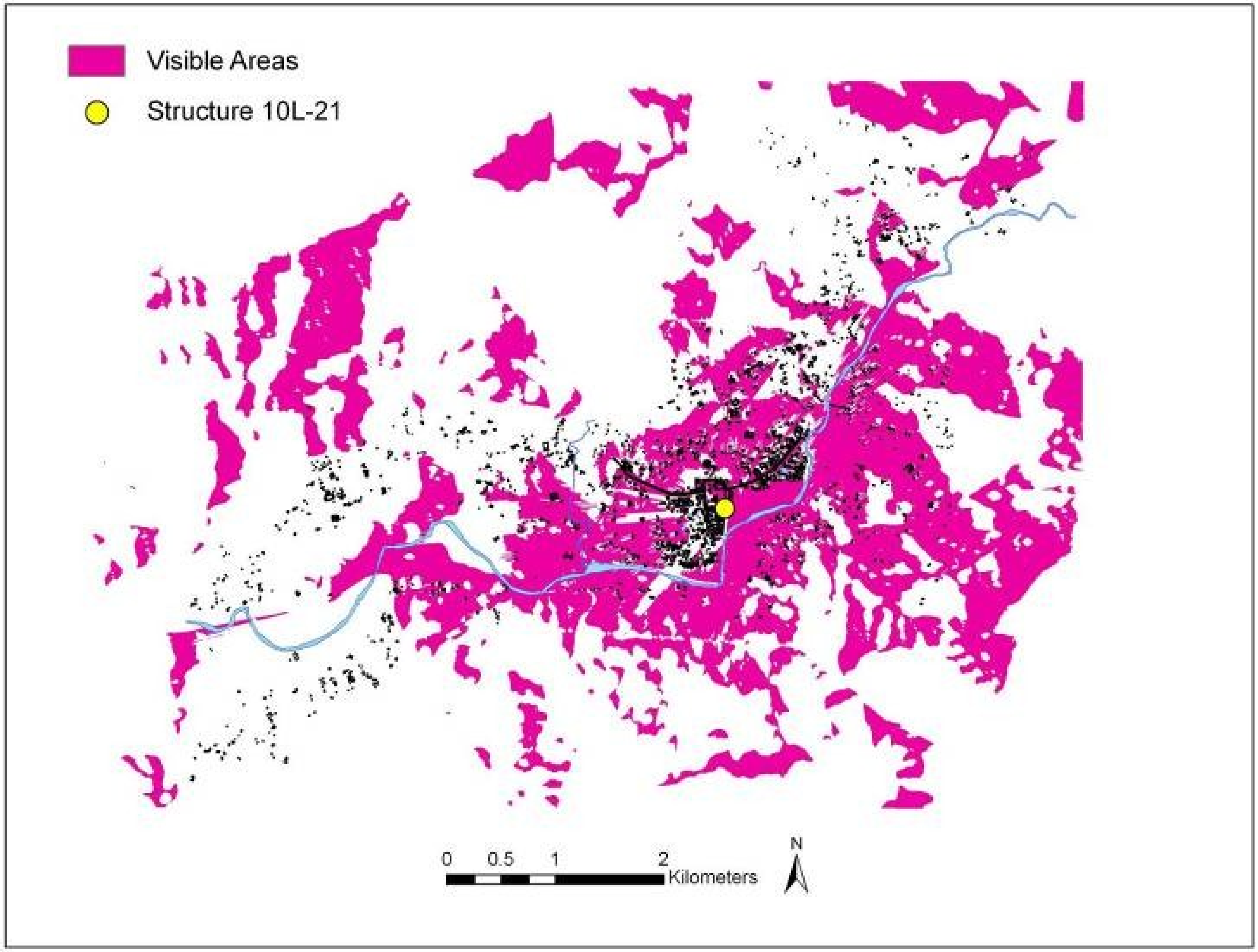
Map H.2: Viewshed of Structure 10L-11, Acropolis, Principal Group



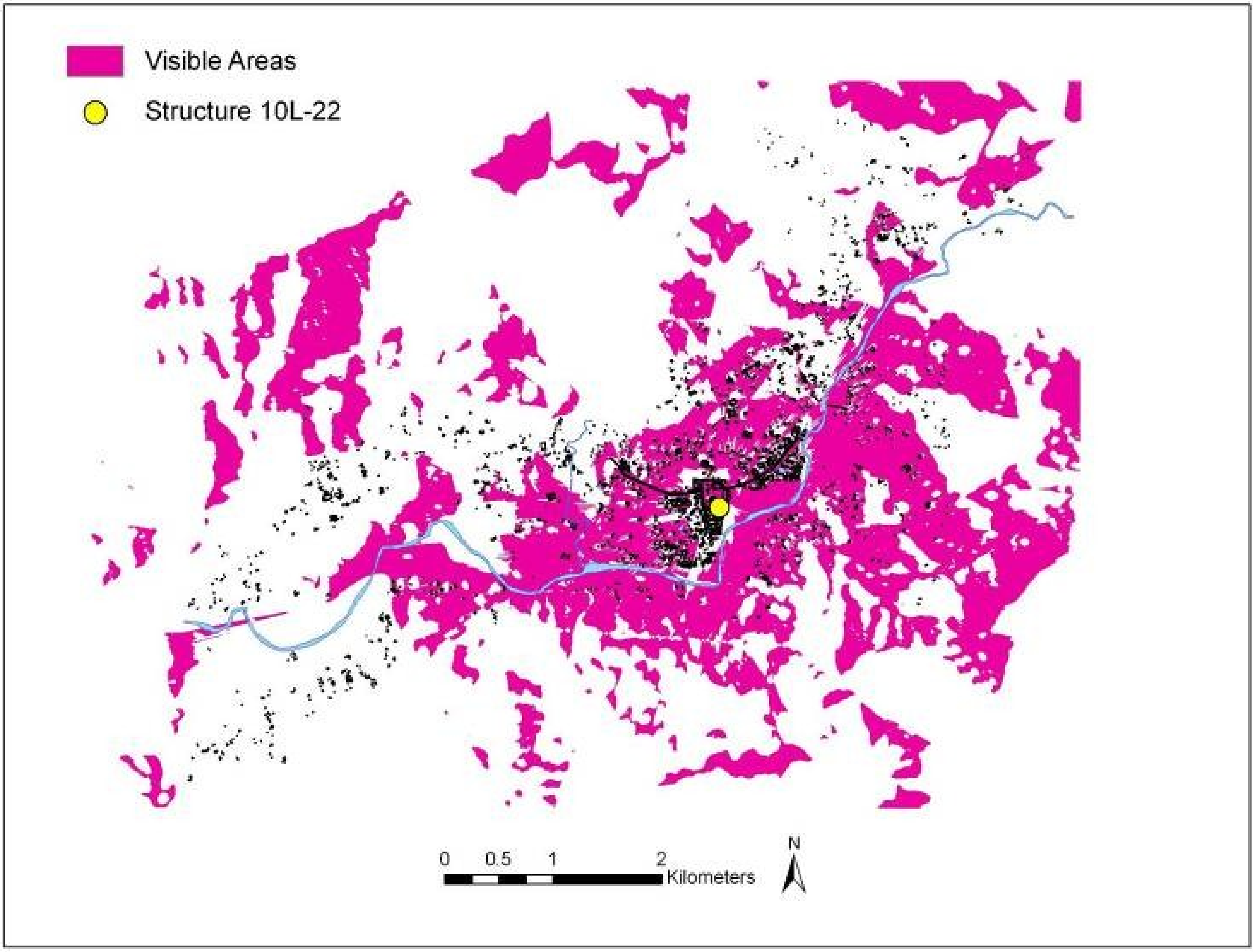
Map H.3: Viewshed of Structure 10L-16, Acropolis, Principal Group



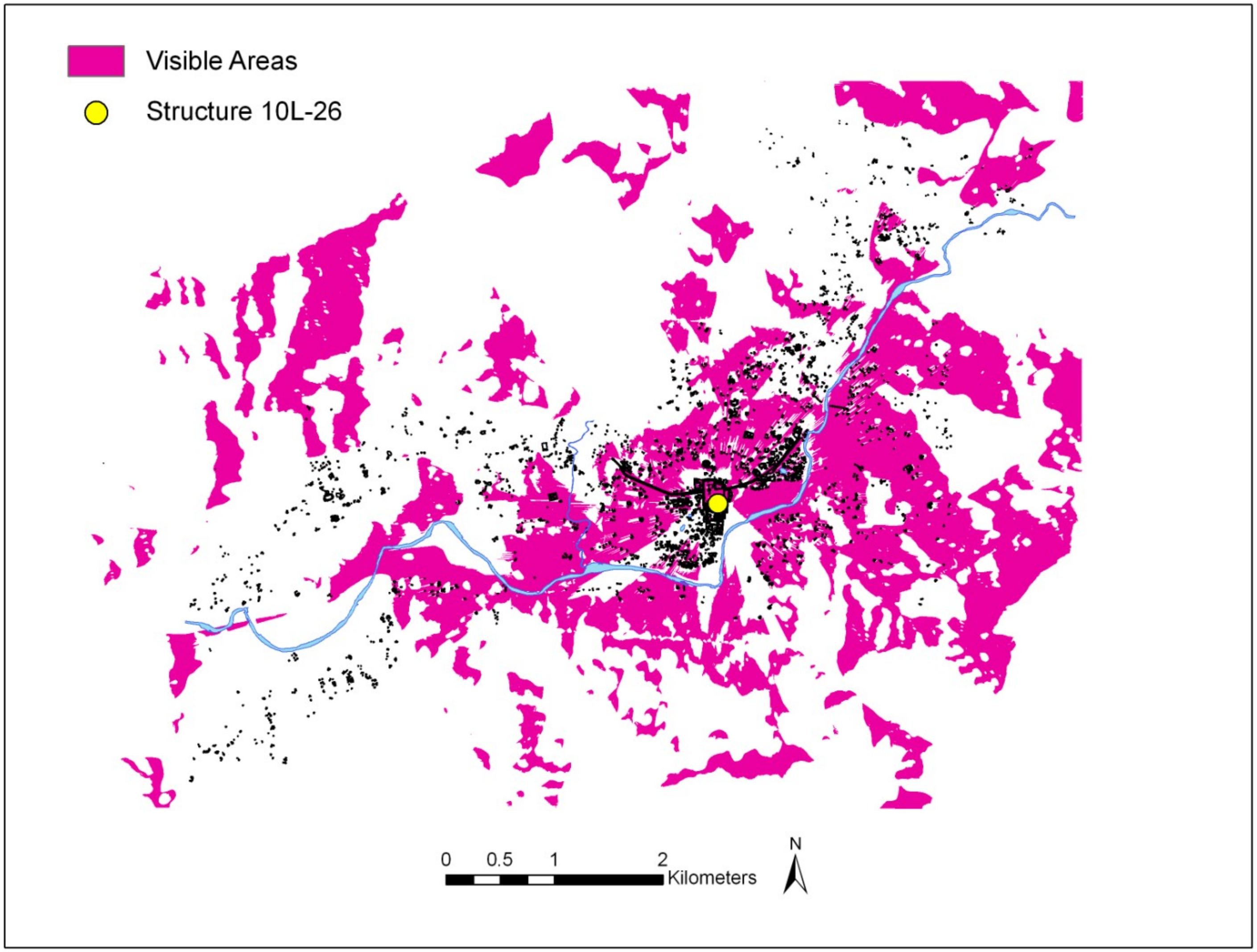
Map H.4: Viewshed of Structure 10L-18, Acropolis, Principal Group



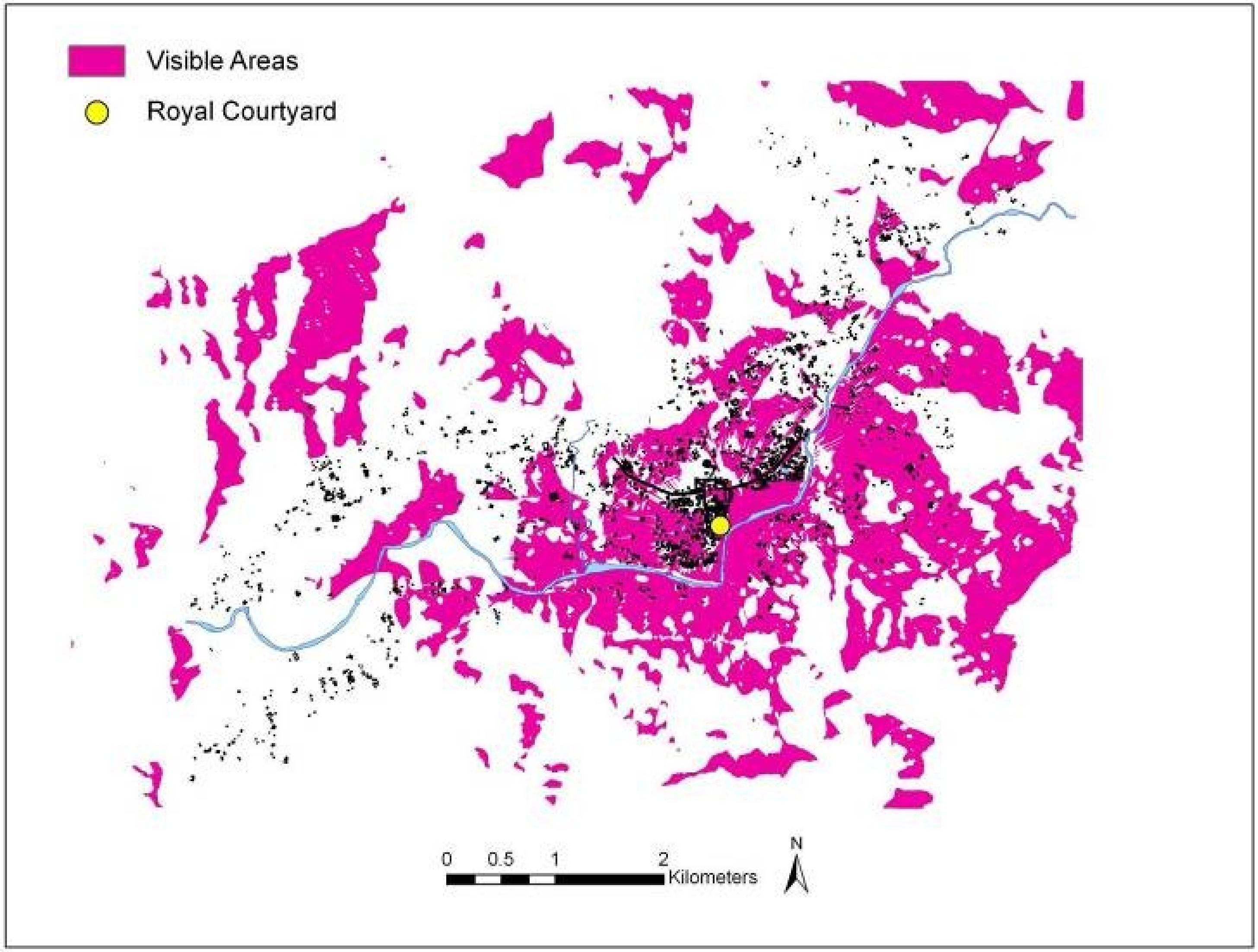
Map H.5: Viewshed of Structure 10L-21, Acropolis, Principal Group



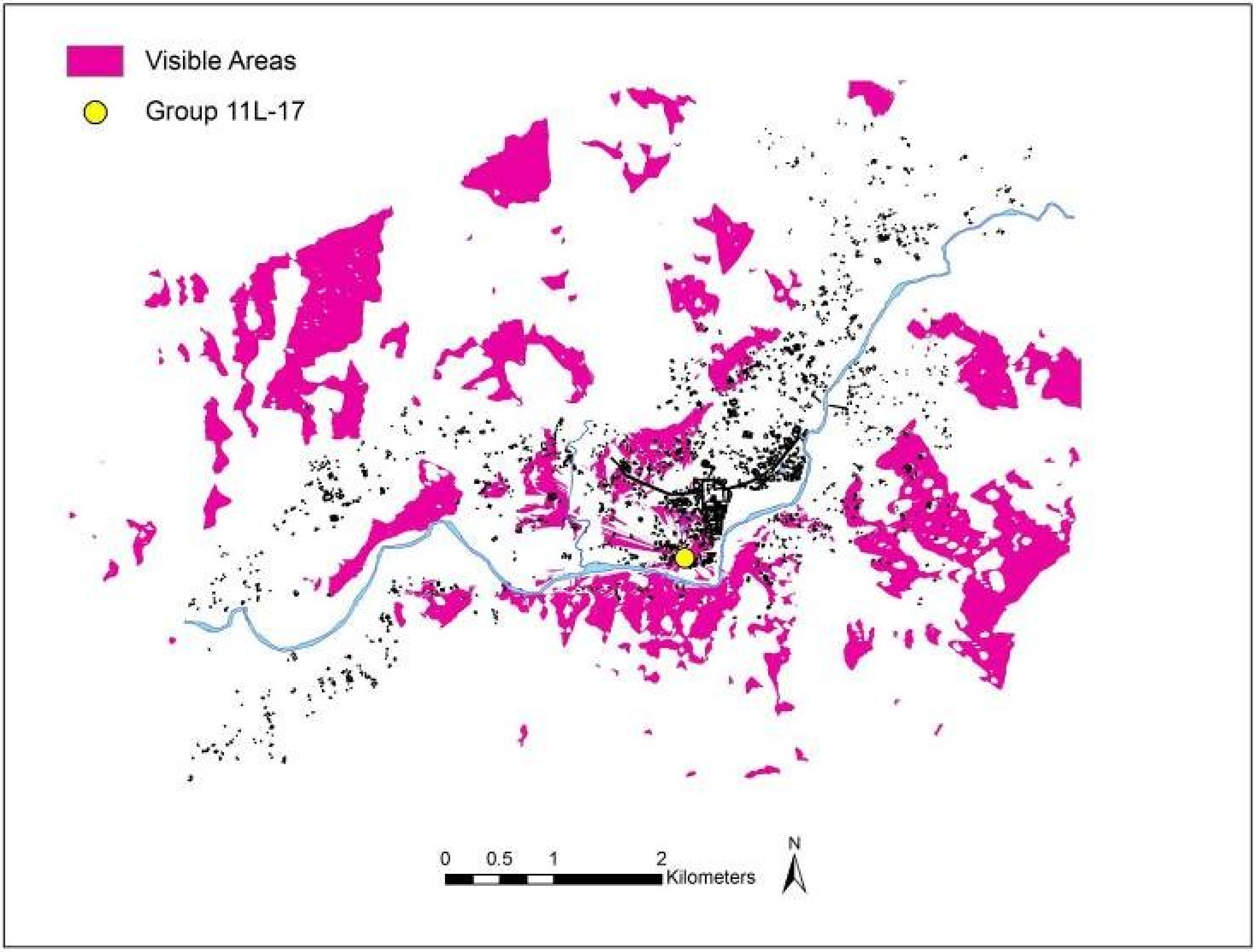
Map H.6: Viewshed of Structure 10L-22, Acropolis, Principal Group



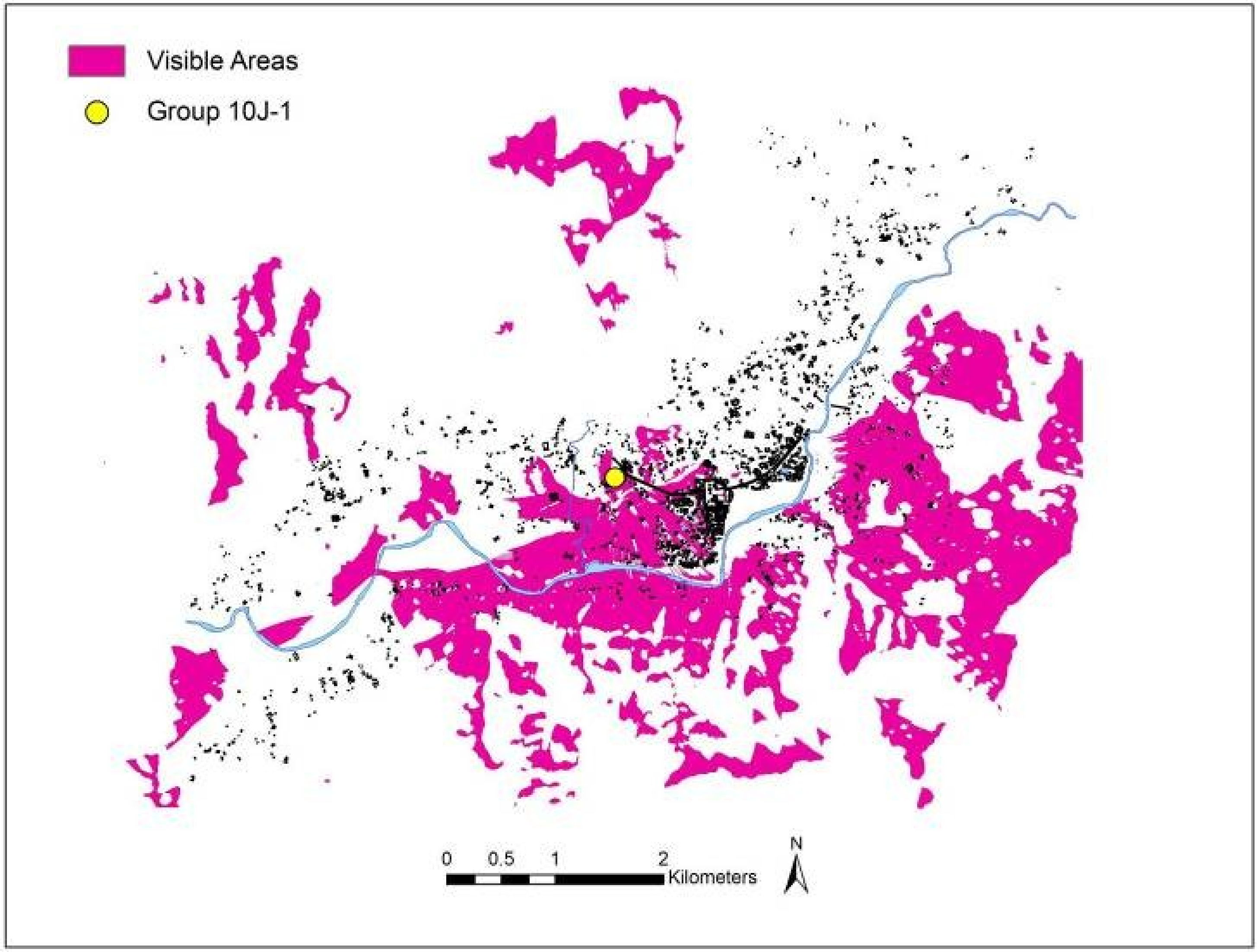
Map H.7: Viewshed of Structure 10L-26, Principal Group



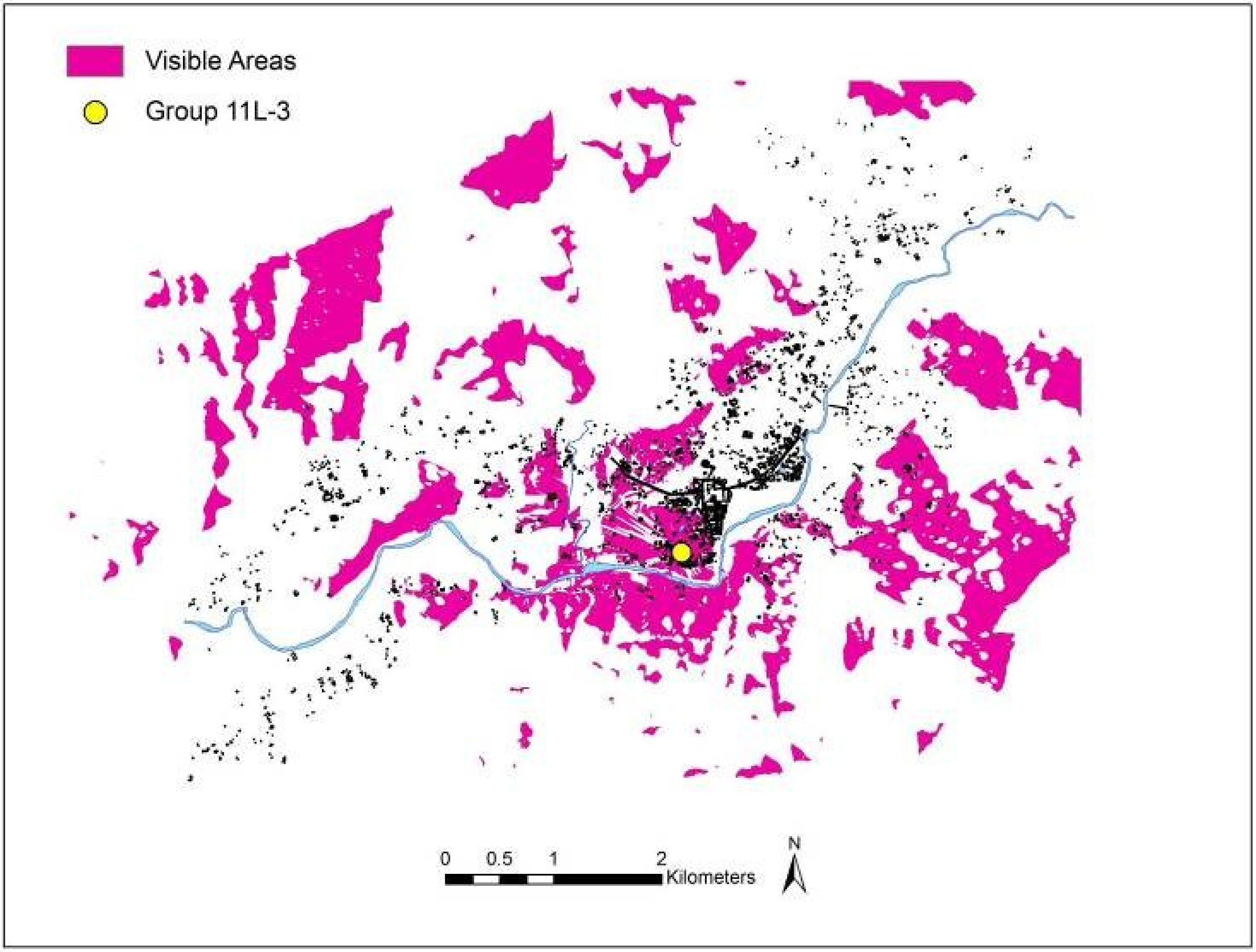
Map H.8: Viewshed of Royal Courtyard (Group 10L-2), Principal Group



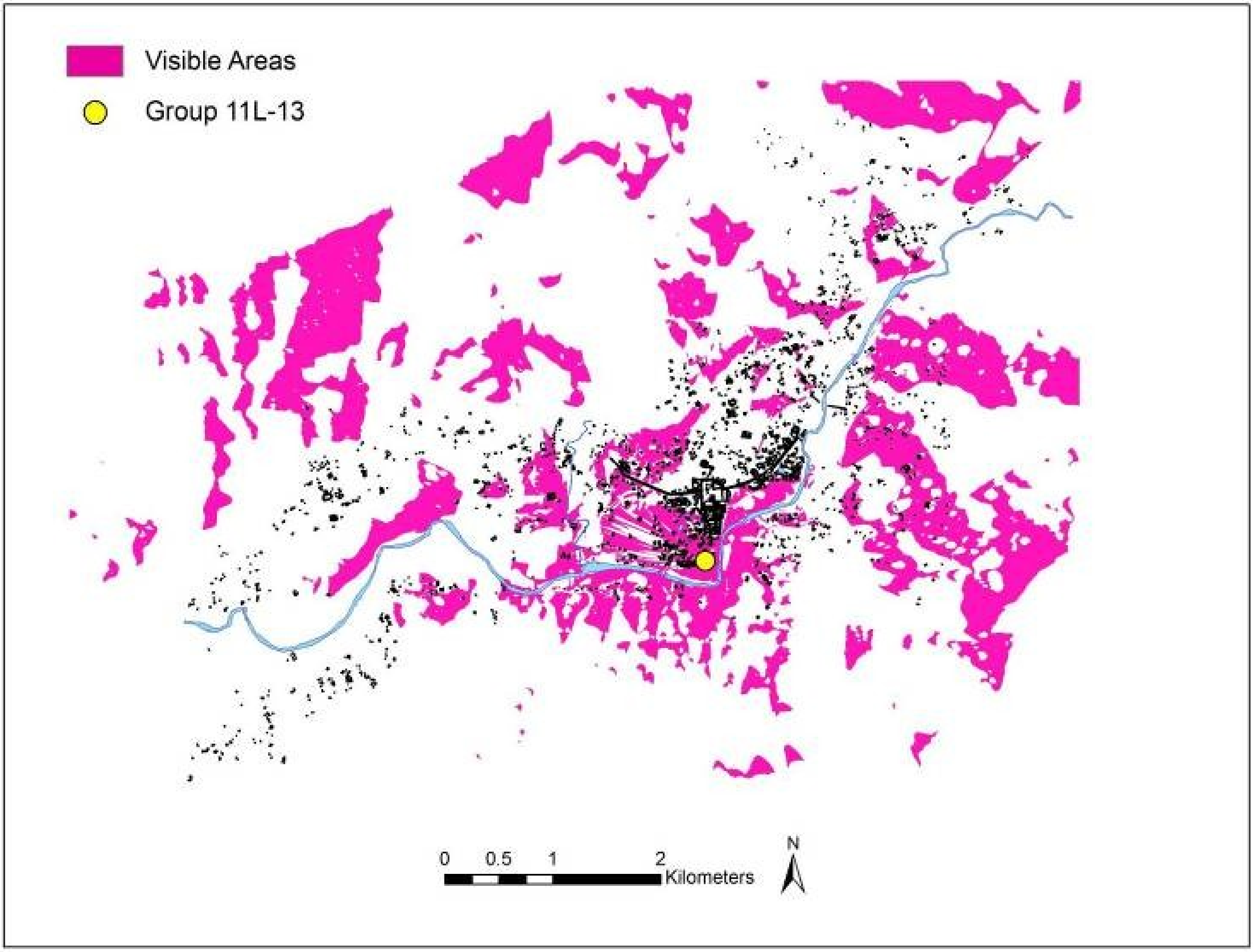
Map H.9: Viewshed of Group 11L-17 (Type 1), El Bosque



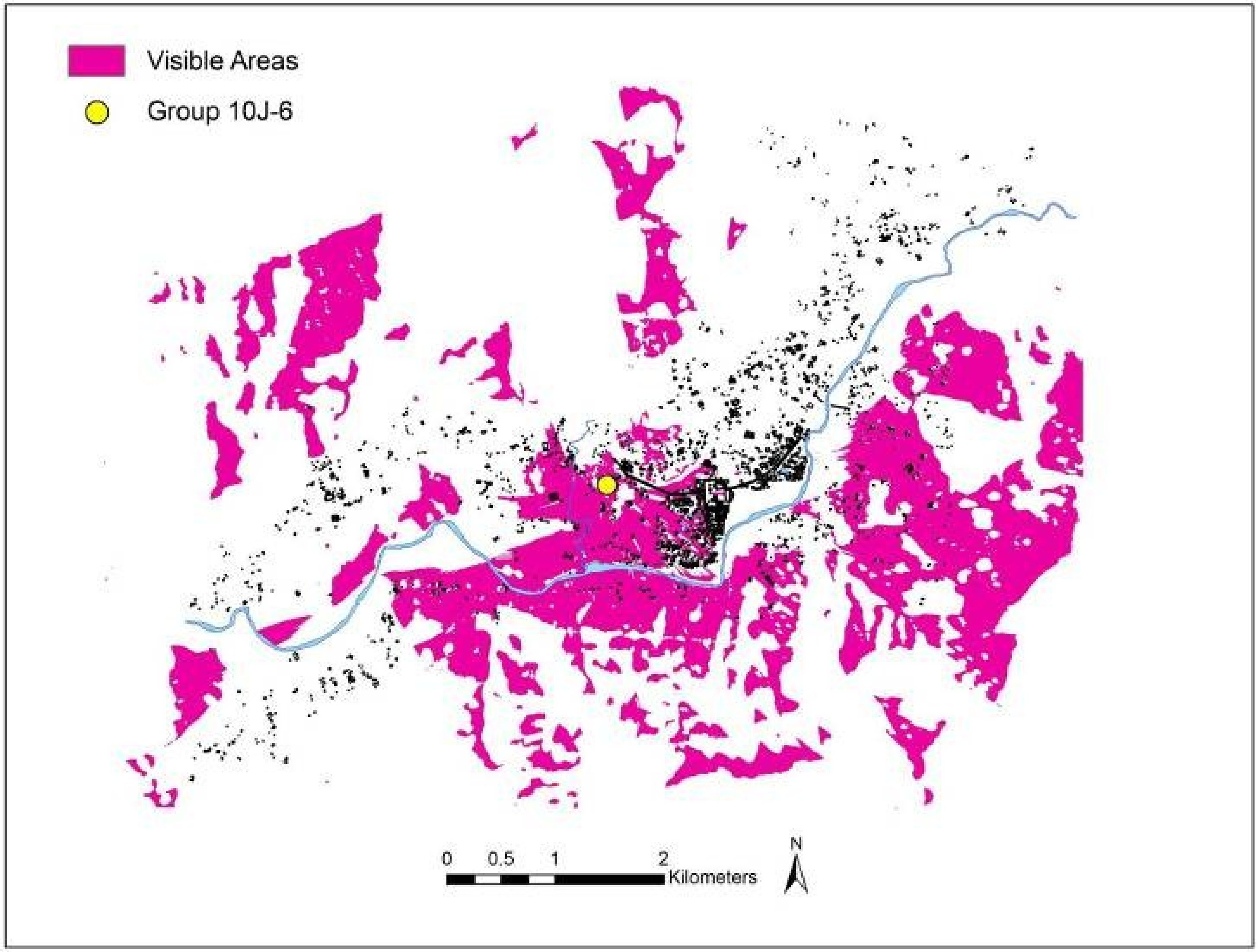
Map H.10: Viewshed of Group 10J-1 (Type 1), El Bosque



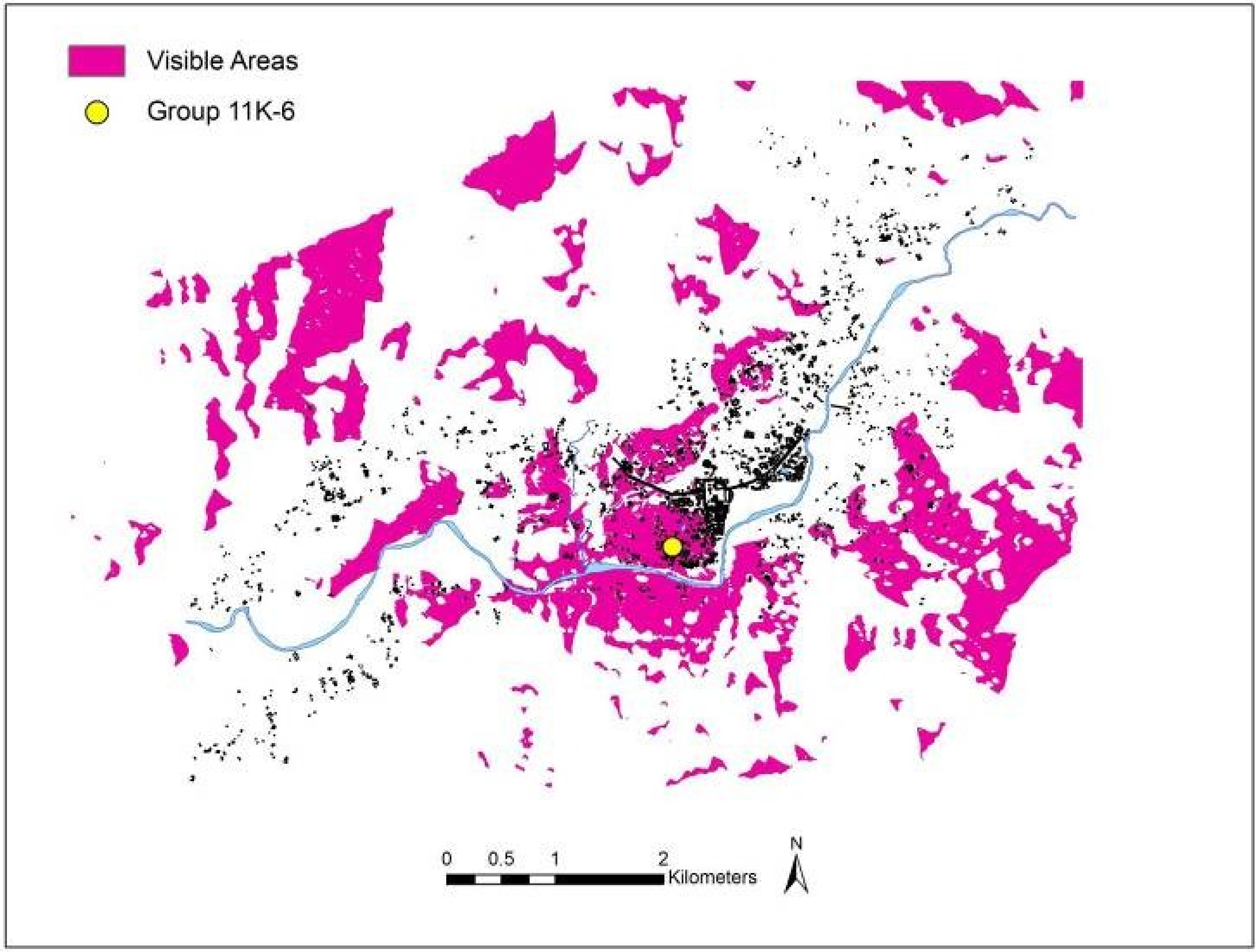
Map H.11: Viewshed of Group 11L-3 (Type 2), El Bosque



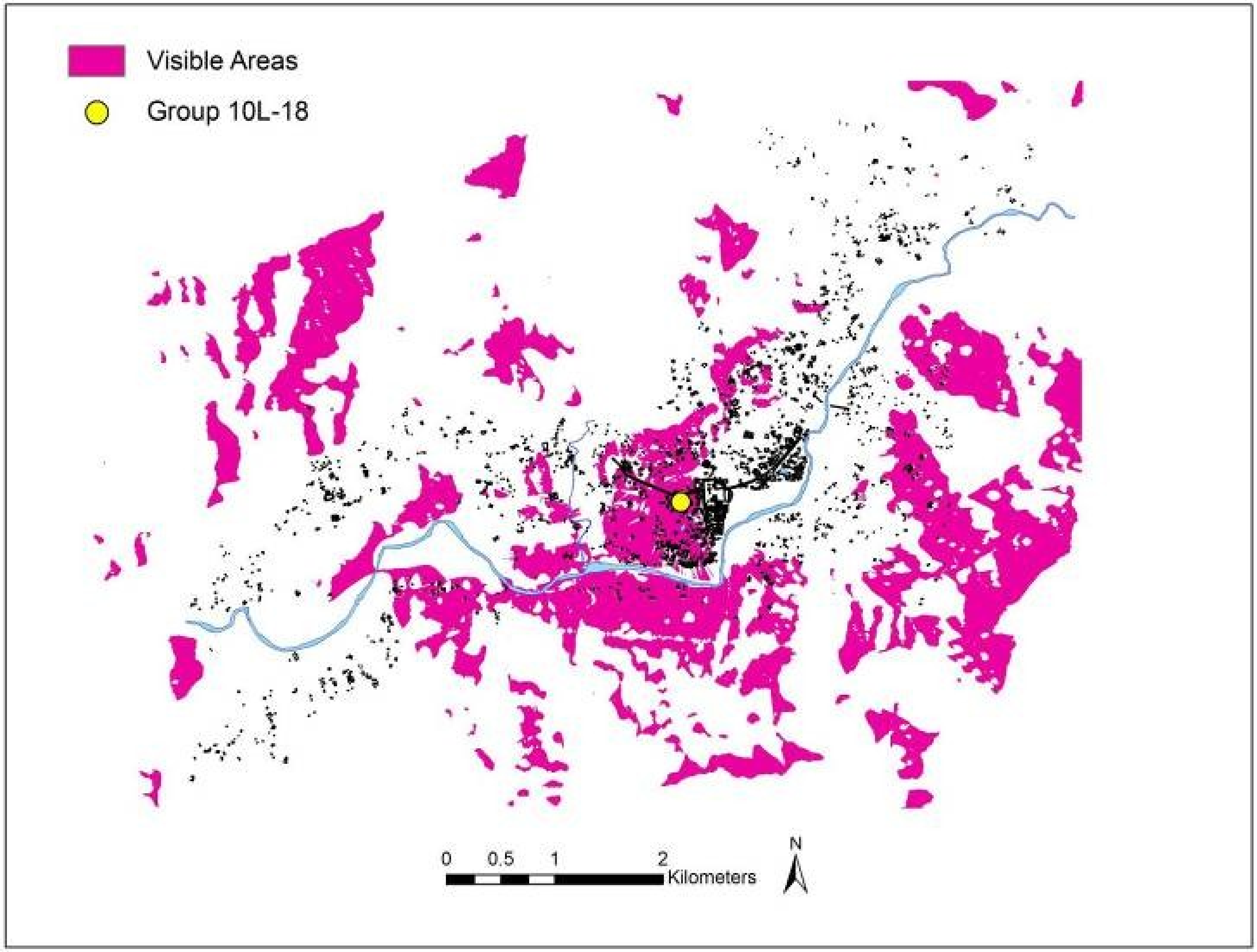
Map H.12: Viewshed of Group 11L-13 (Type 3), El Bosque



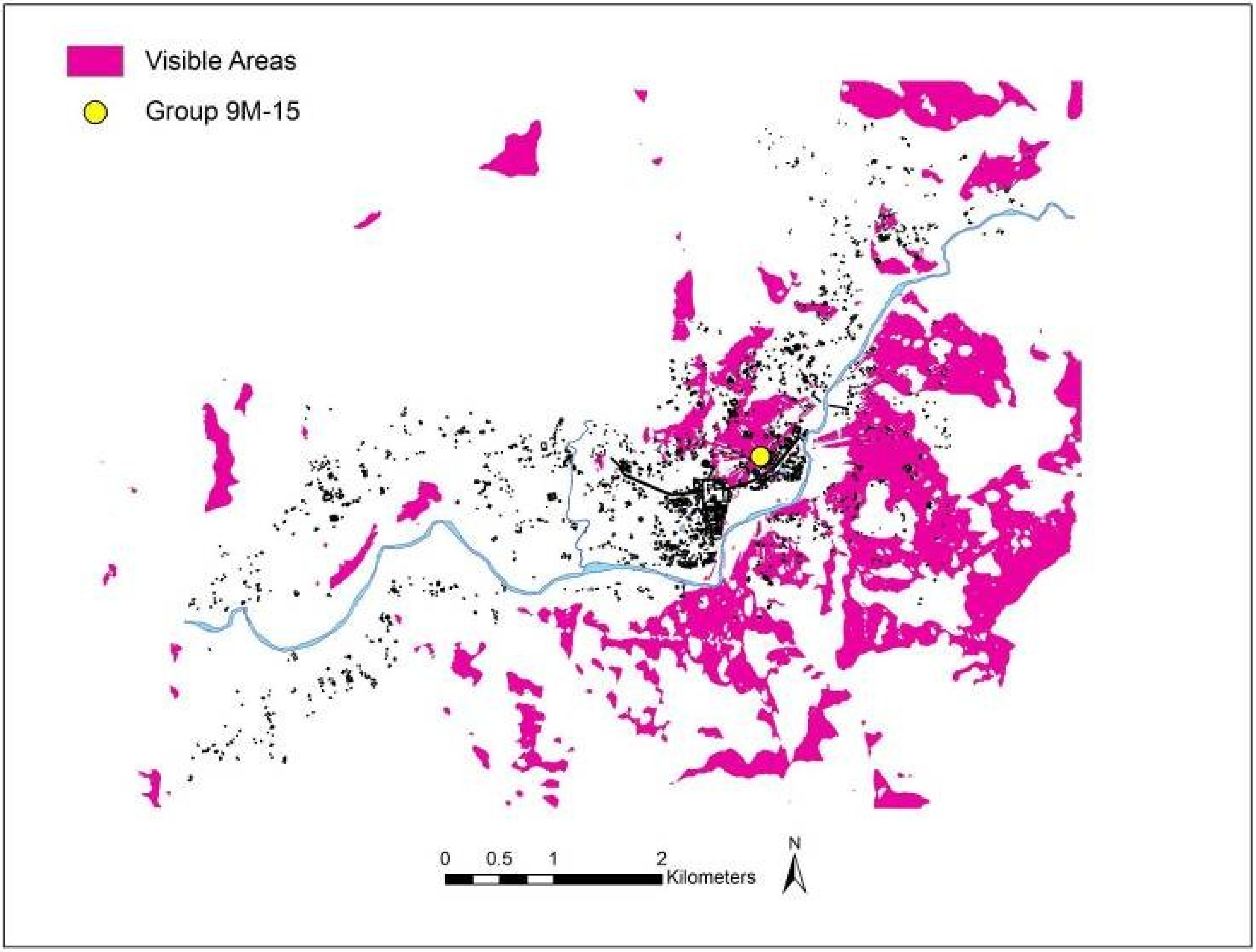
Map H.13: Viewshed of Group 10J-6 (Type 3), El Bosque



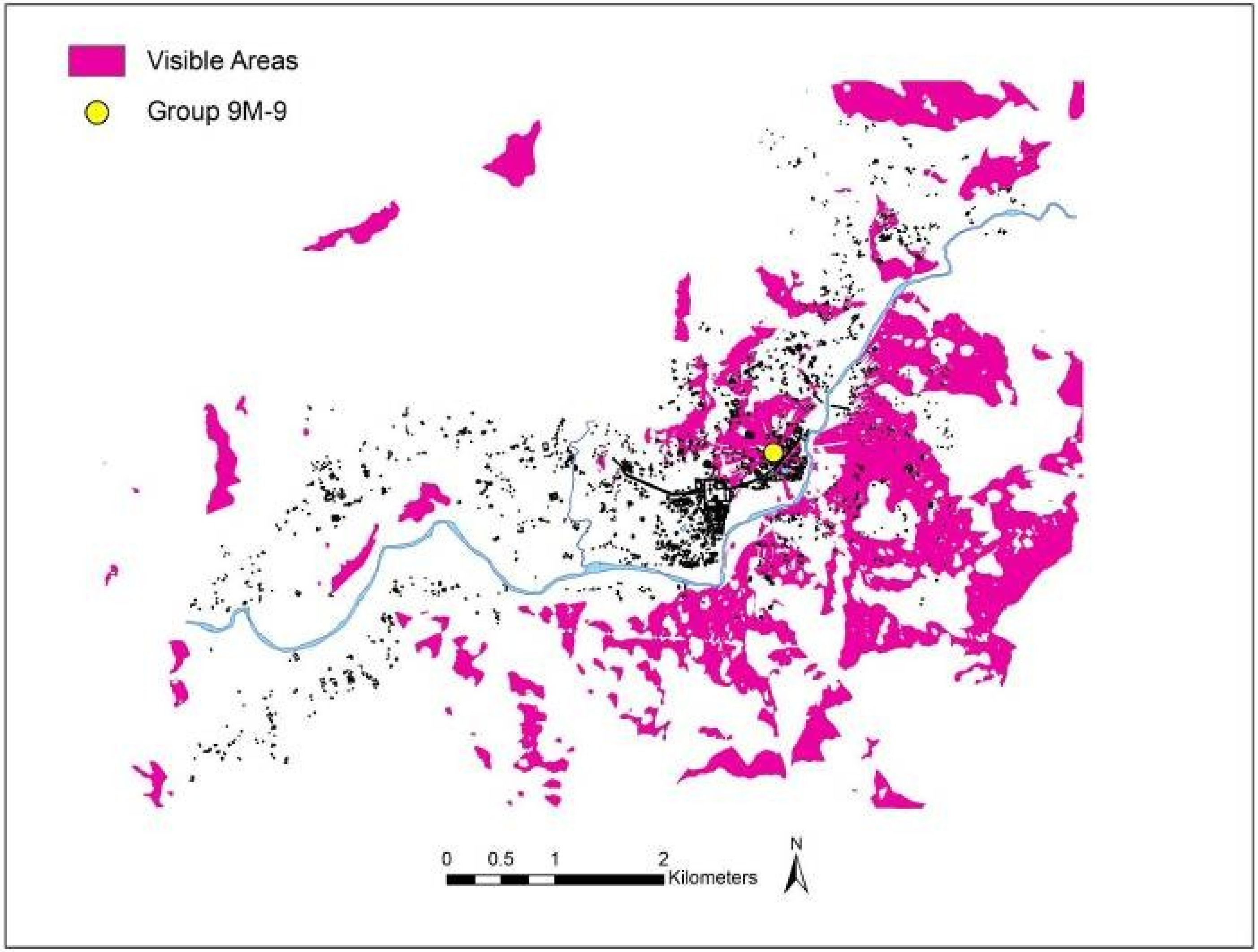
Map H.14: Viewshed of Group 11K-6 (Type 4), El Bosque



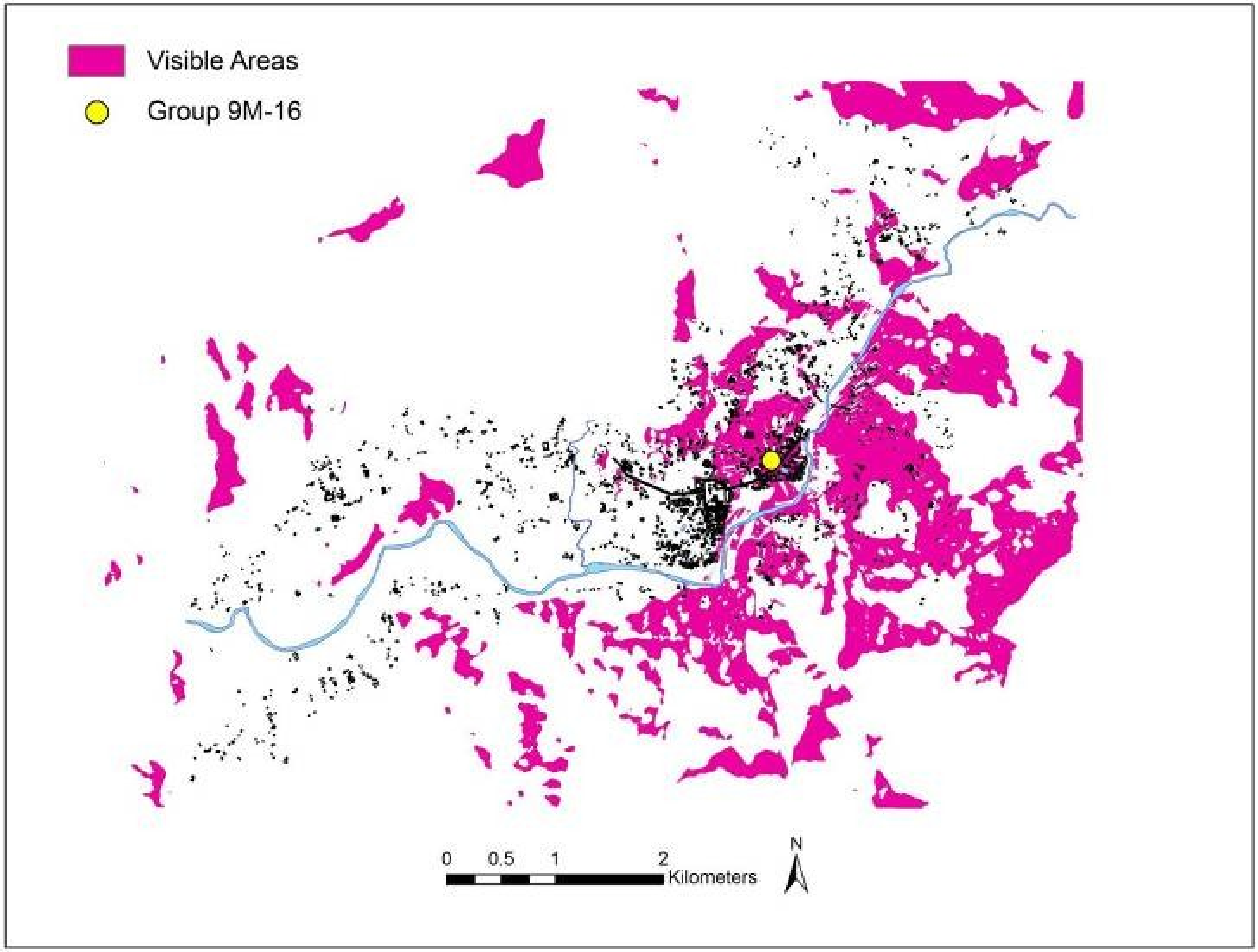
Map H.15: Viewshed of Group 10L-18 (Type 4), El Bosque



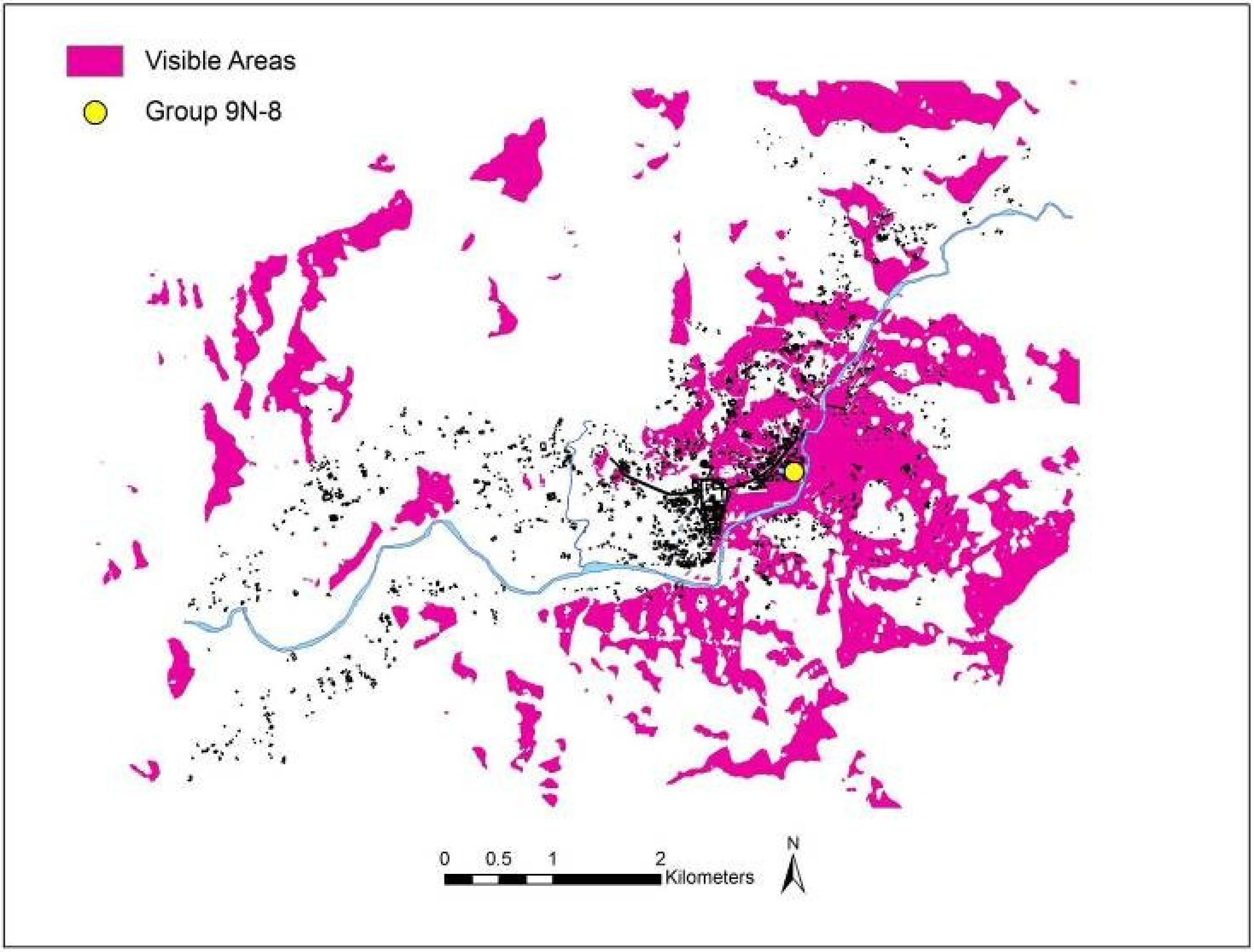
Map H.16: Viewshed of Group 9M-15 (Type 1), Las Sepulturas



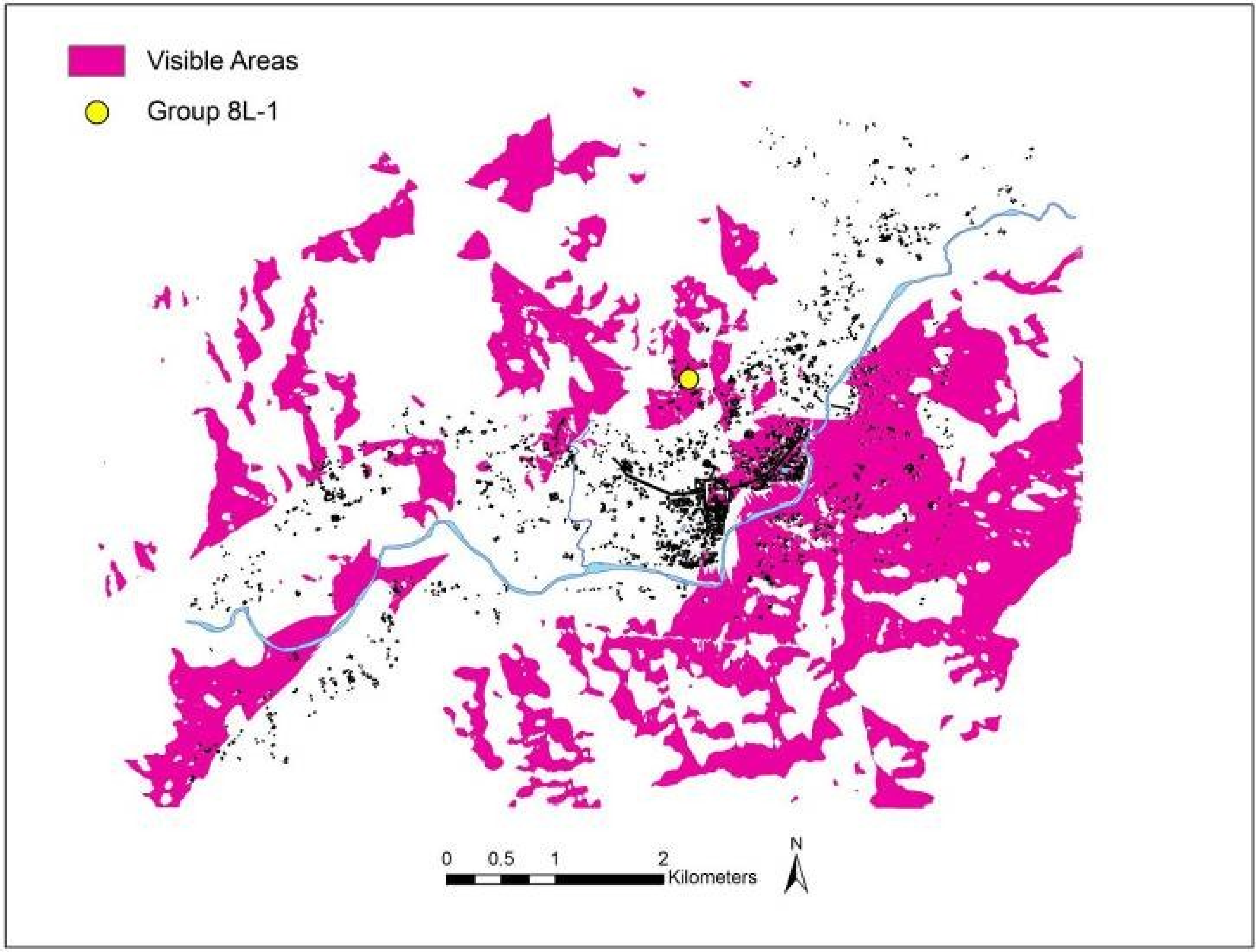
Map H.17: Viewshed of Group 9M-9 (Type 2), Las Sepulturas



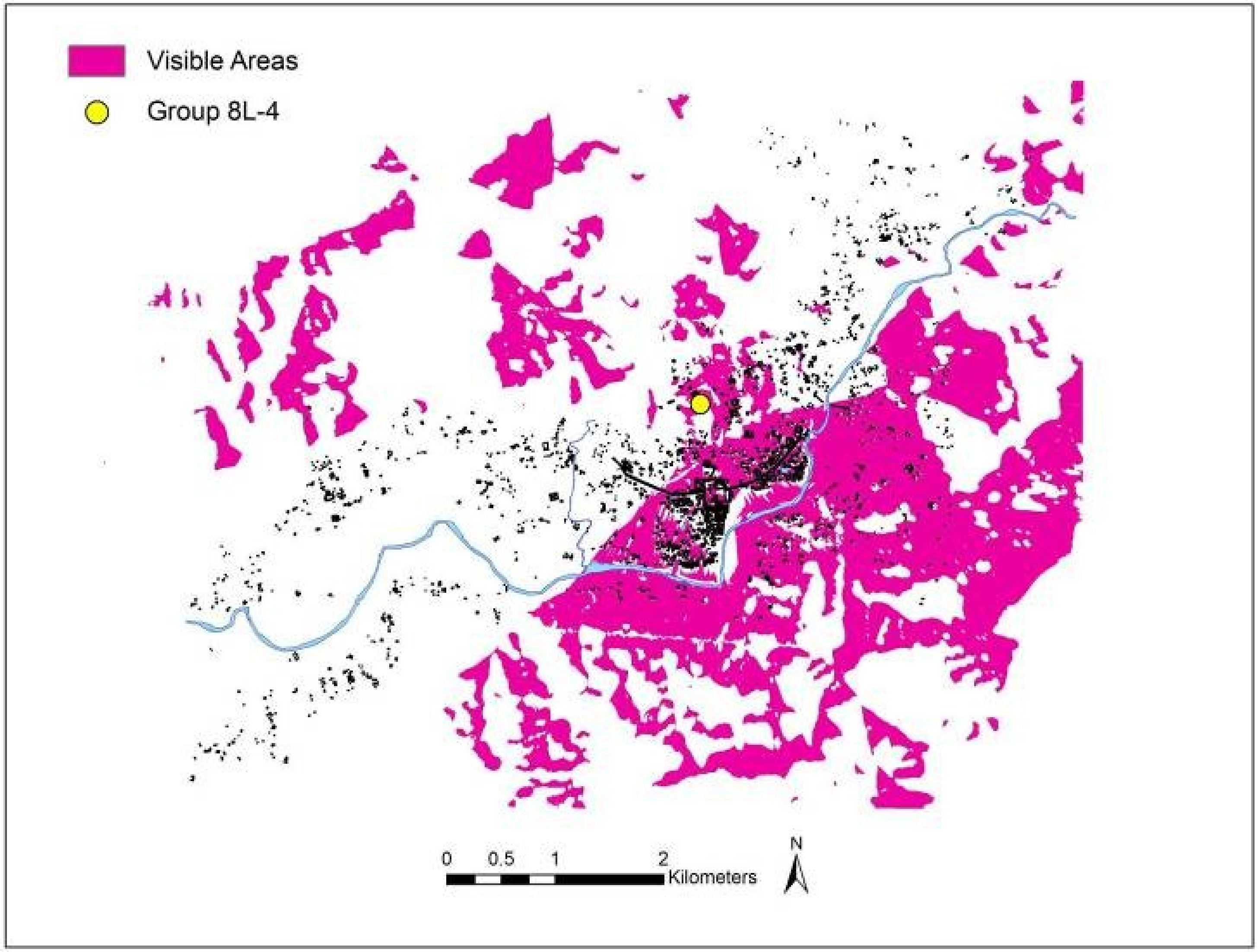
Map H.18: Viewshed of Group 9M-16 (Type 3), Las Sepulturas



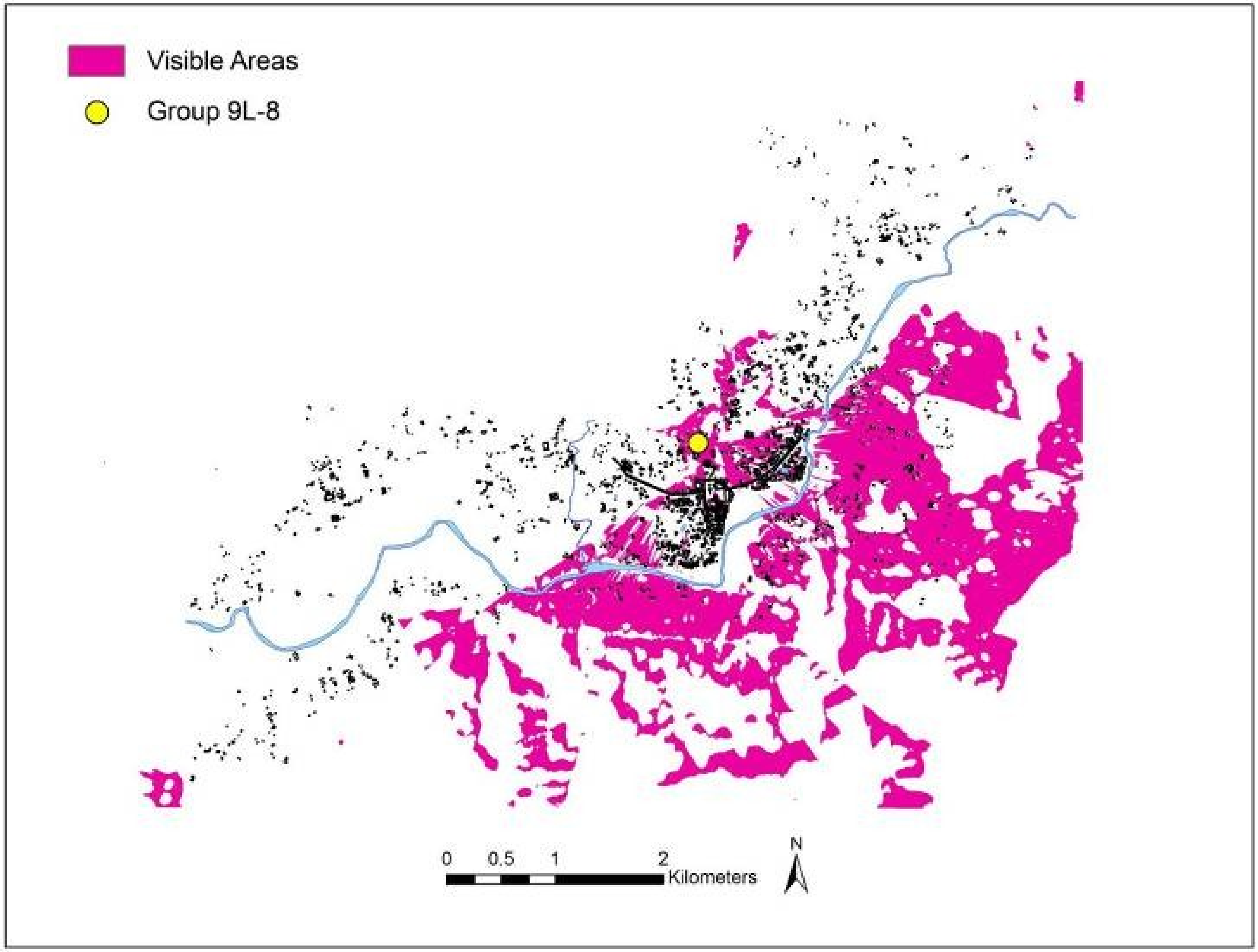
Map H.19: Viewshed of Group 9N-8 (Type 4), Las Sepulturas



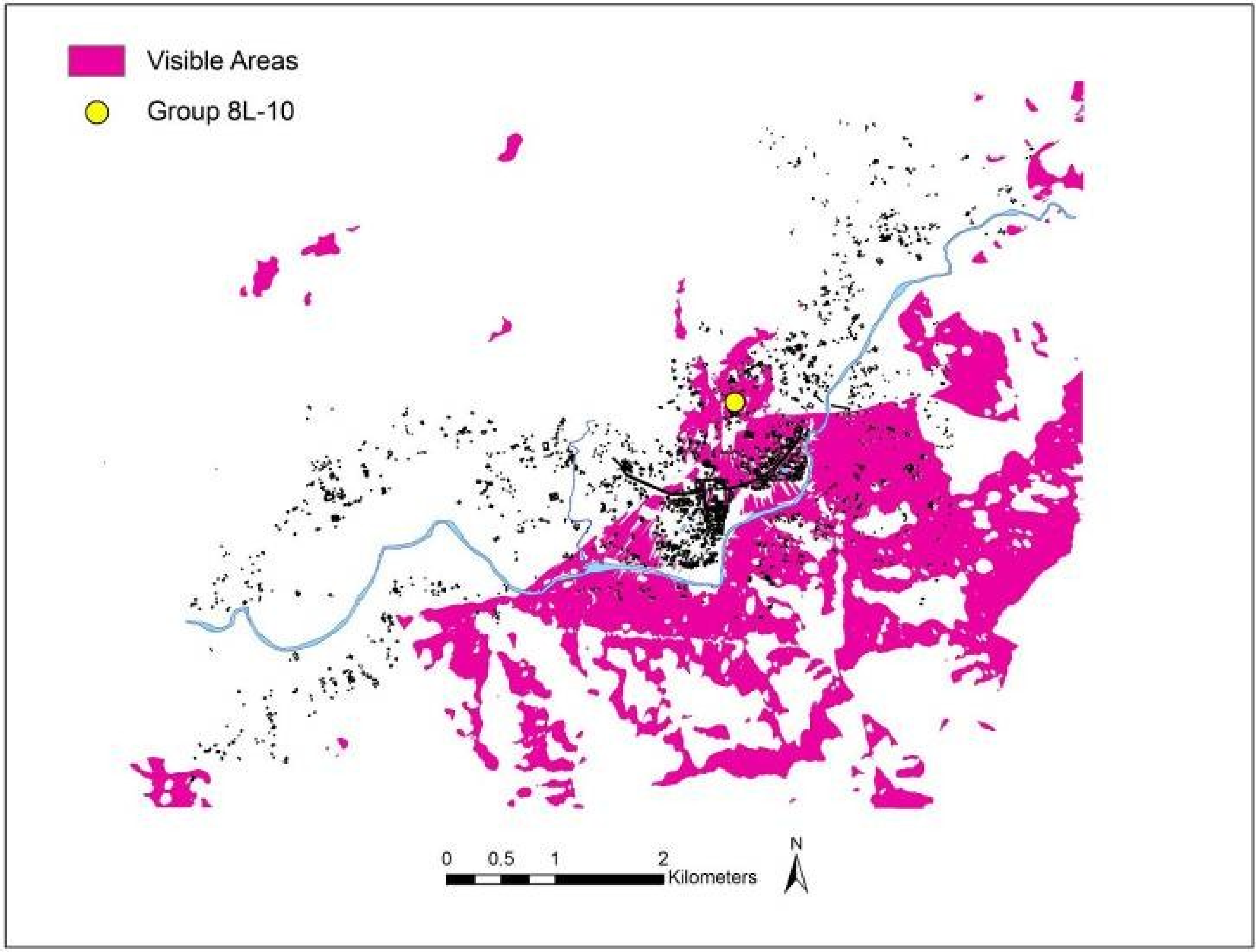
Map H.20: Viewshed of Group 8L-1 (Type 1), Salamar



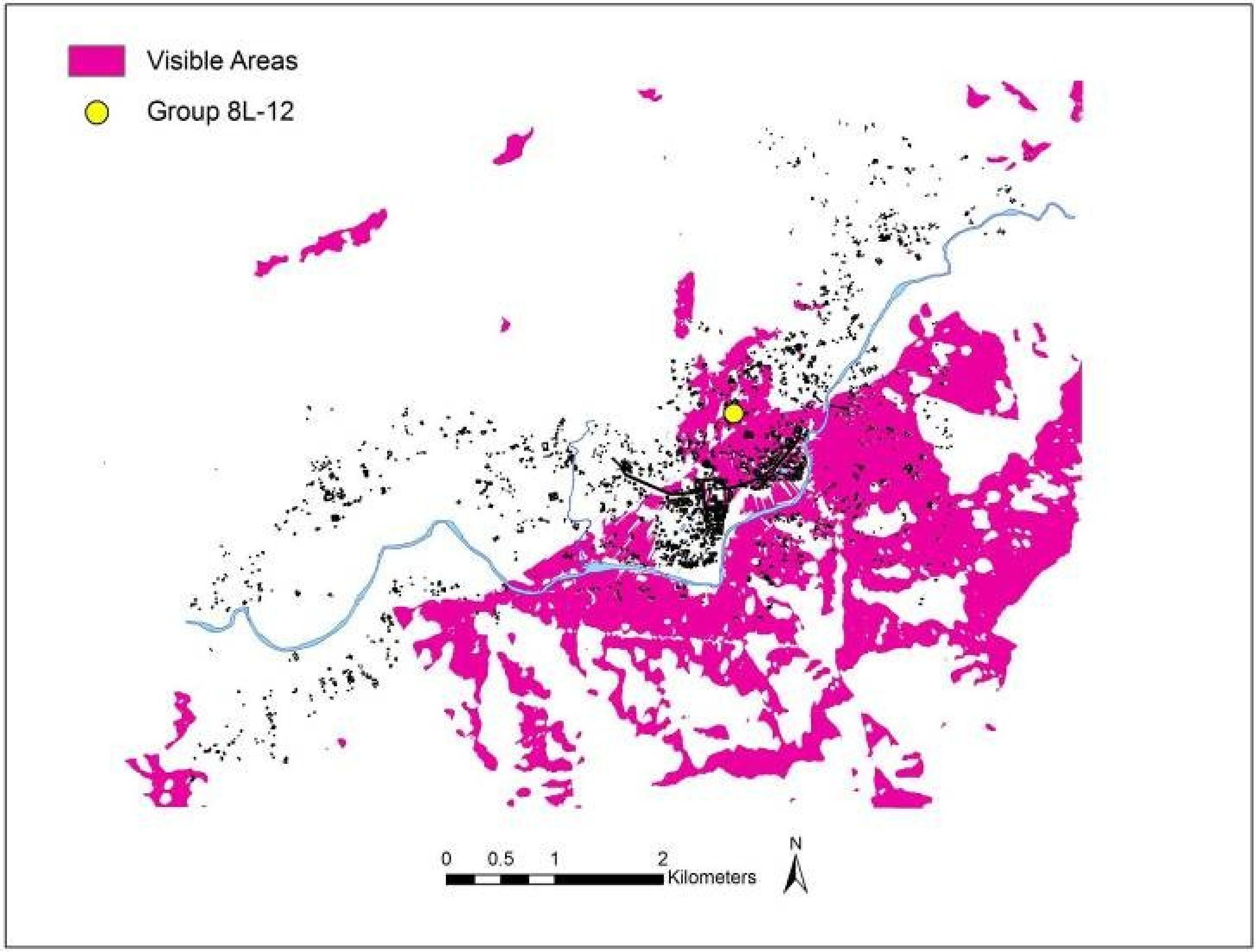
Map H.21: Viewshed of Group 8L-4 (Type 2), Salamar



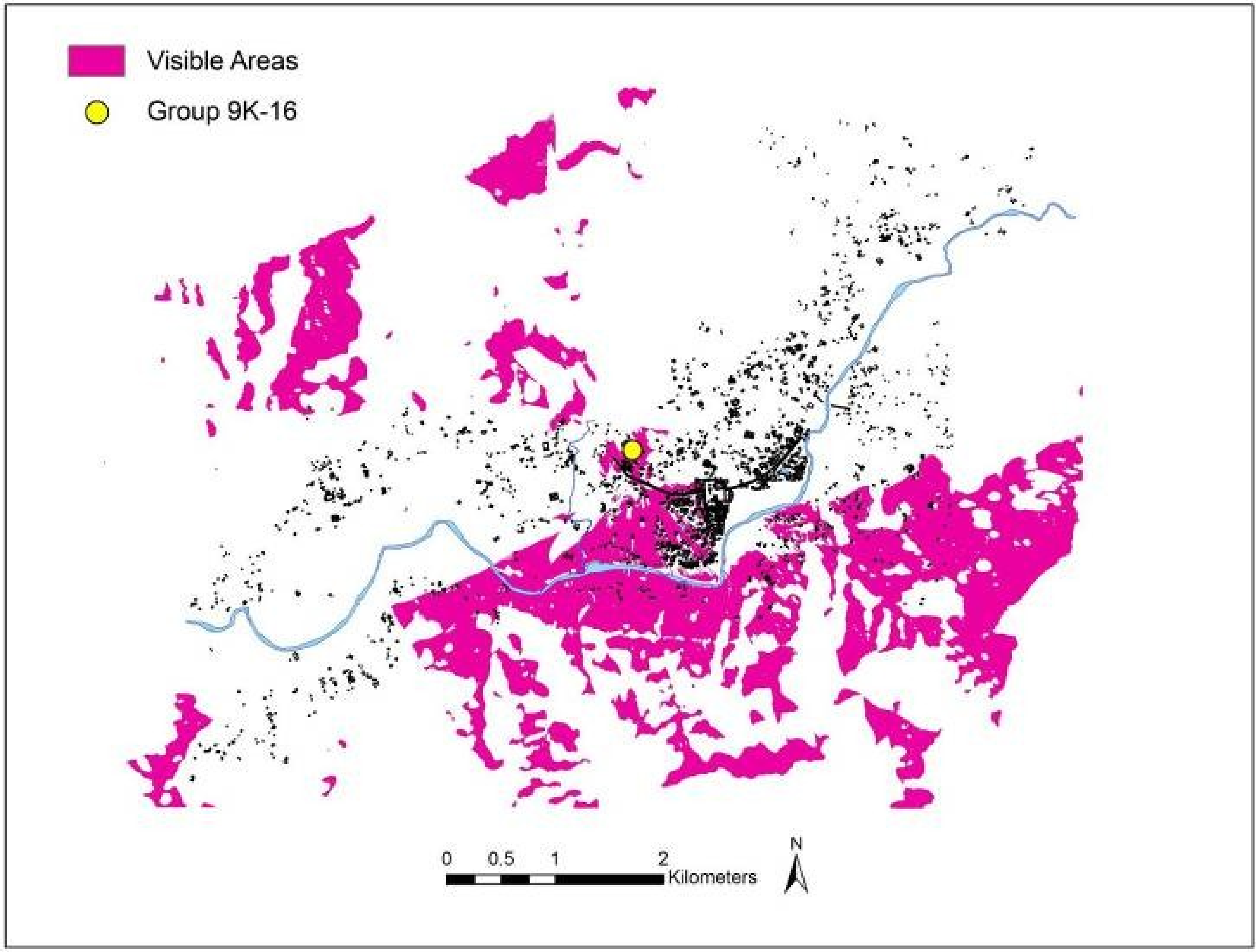
Map H.22: Viewshed of Group 9L-8 (Type 2), Salamar



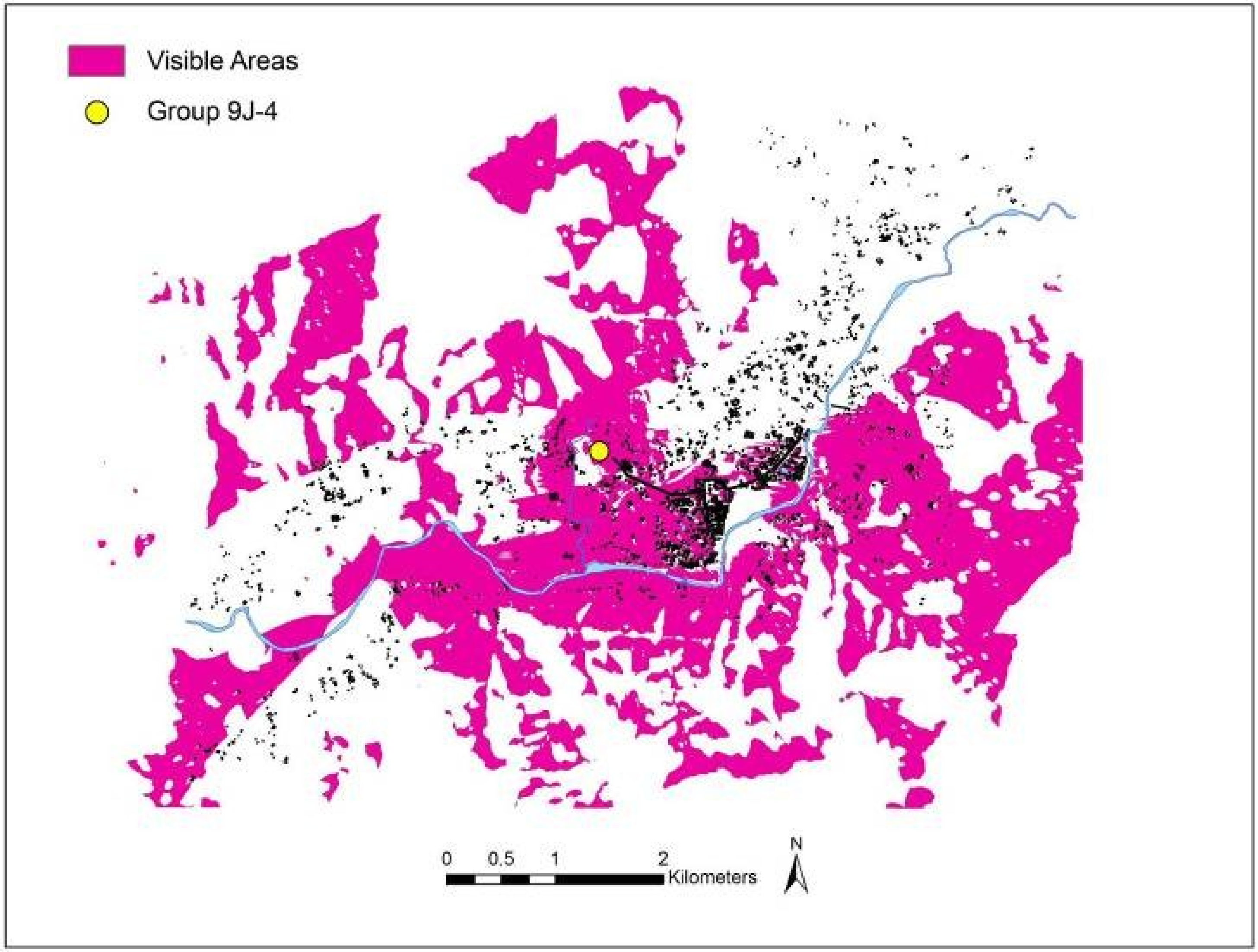
Map H.23: Viewshed of Group 8L-10 (Type 3), Salamar



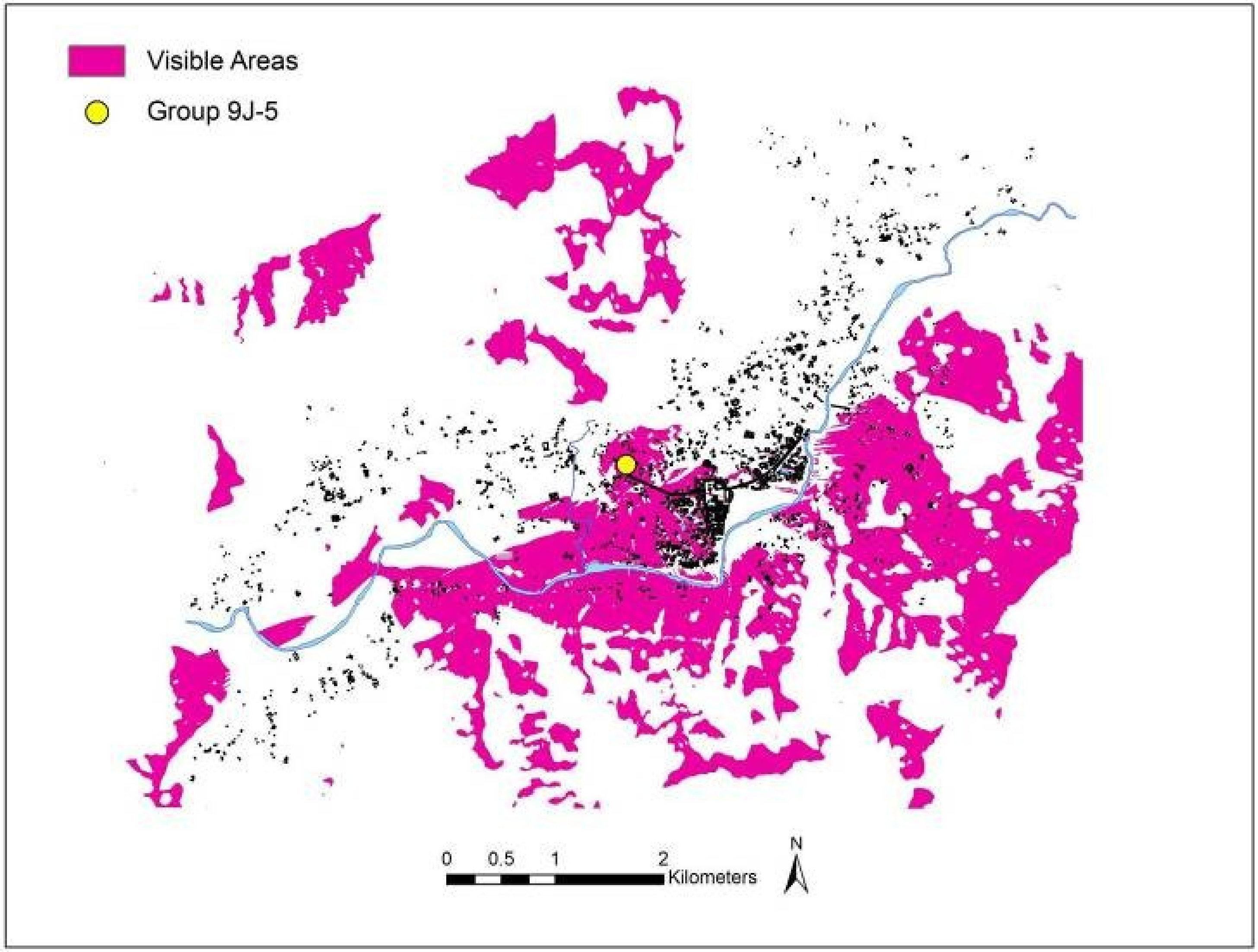
Map H.24: Viewshed of Group 8L-12 (Type 4), Salamar



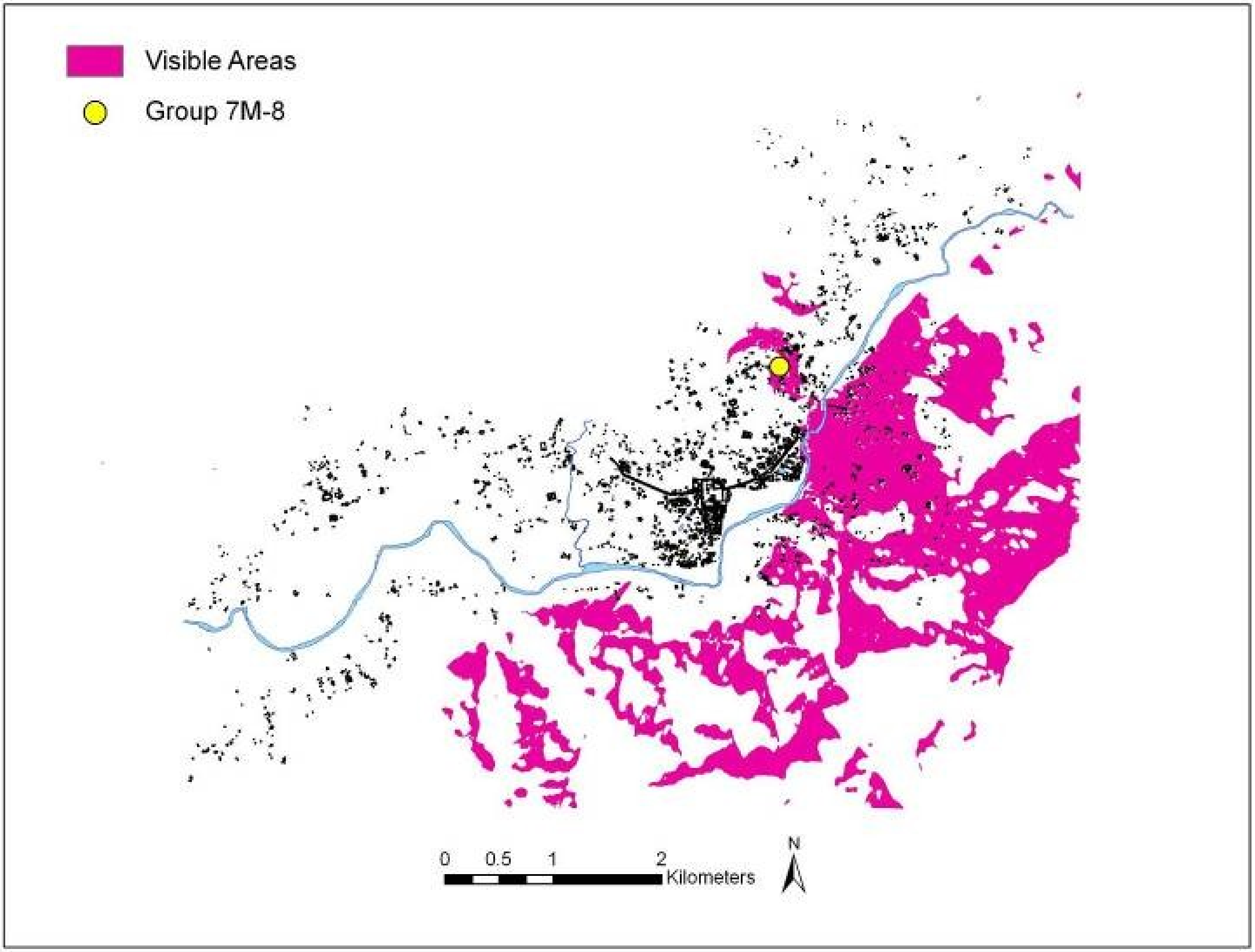
Map H.25: Viewshed of Group 9K-16 (Type 1), Comedero



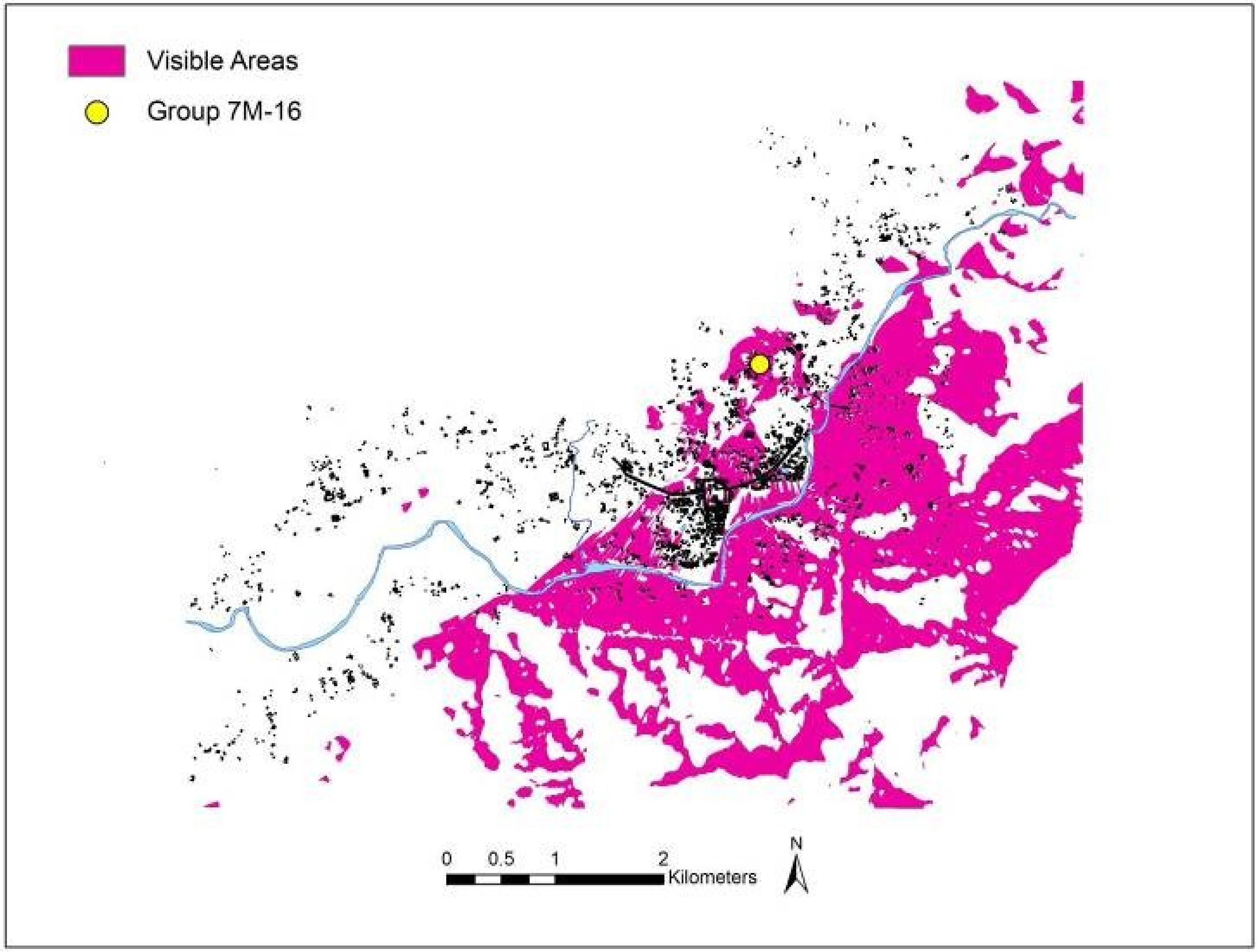
Map H.26: Viewshed of Group 9J-4 (Type 2), Comedero



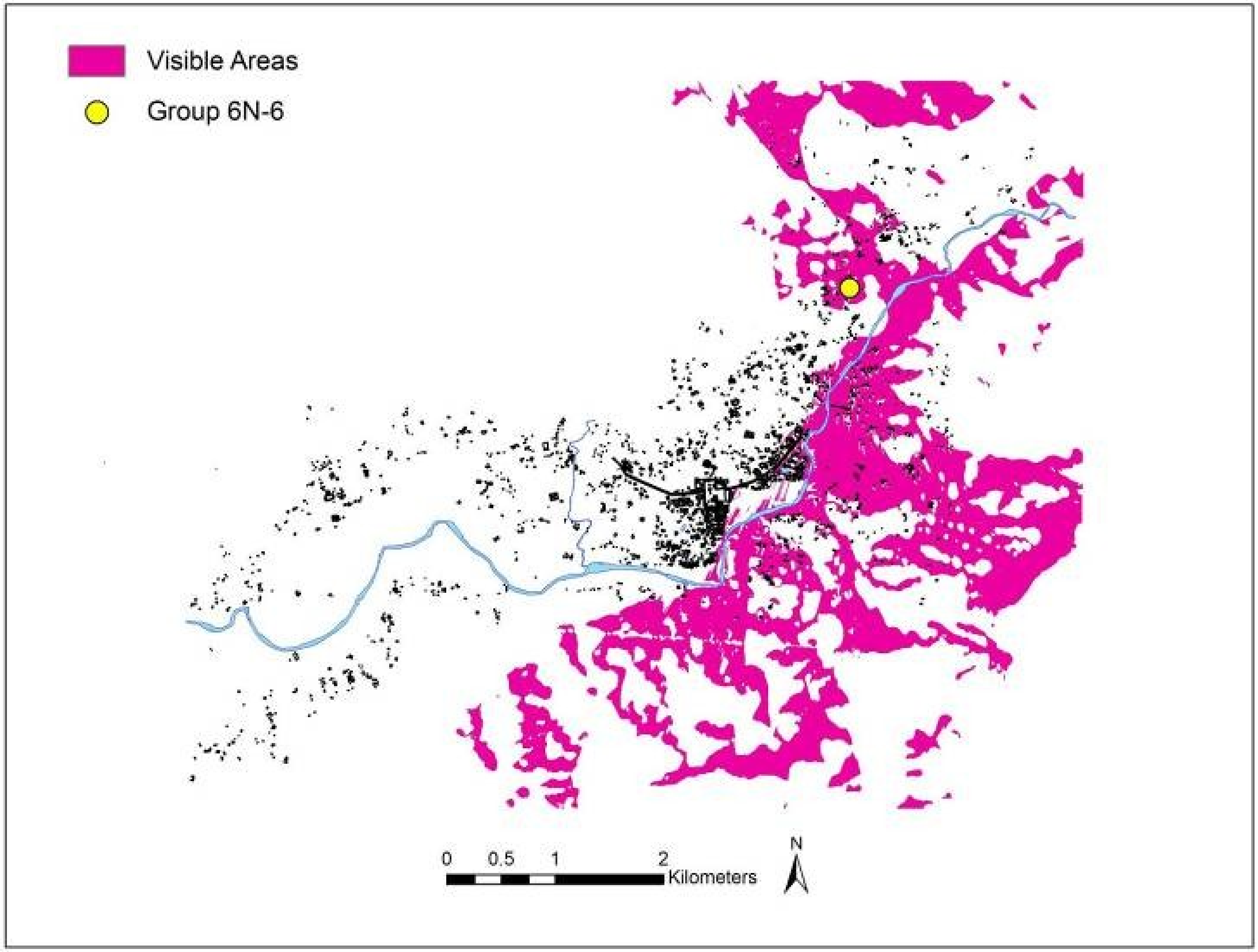
Map H.27: Viewshed of Group 9J-5 (Type 4), Comedero



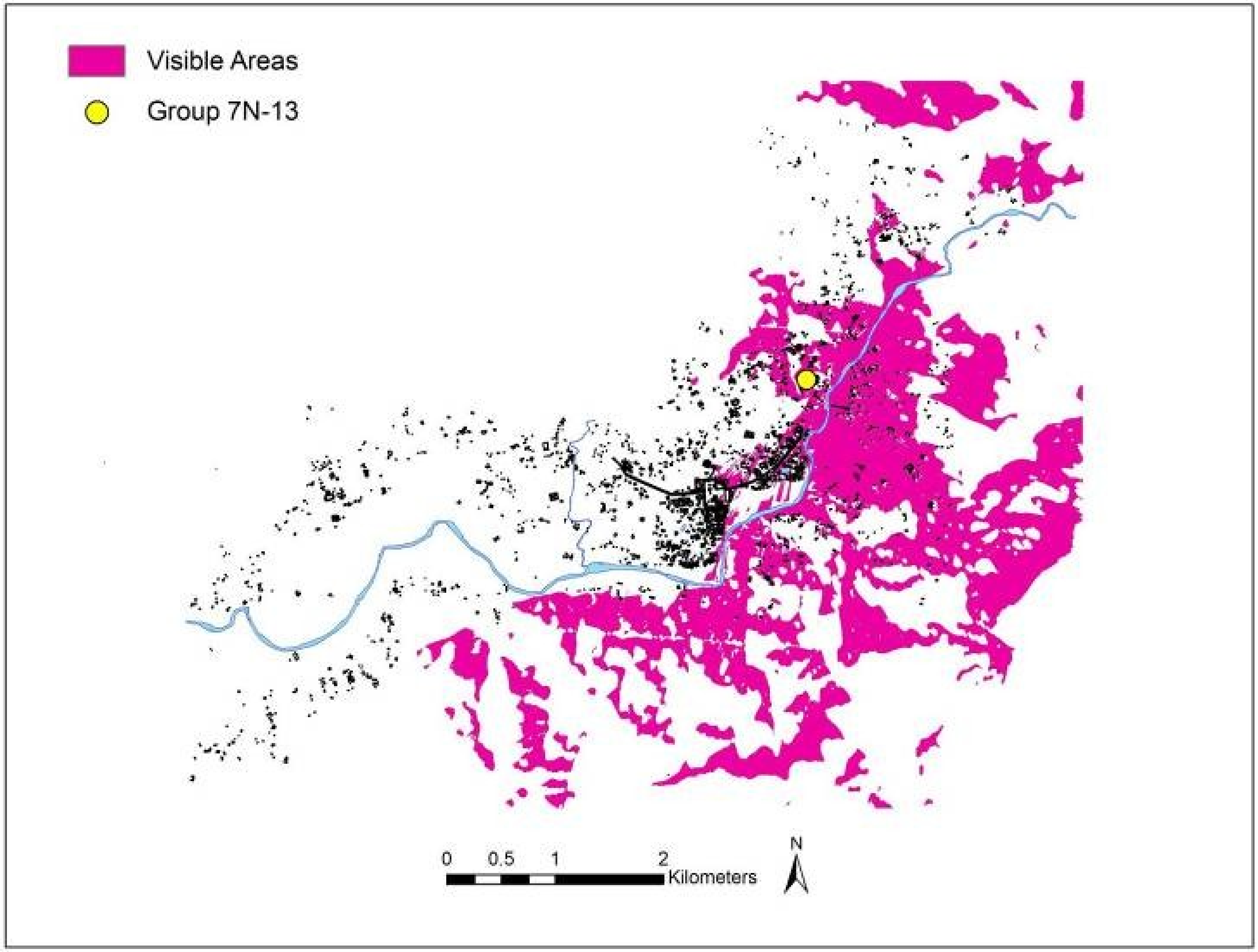
Map H.28: Viewshed of Group 7M-8 (Type 2), Chorro



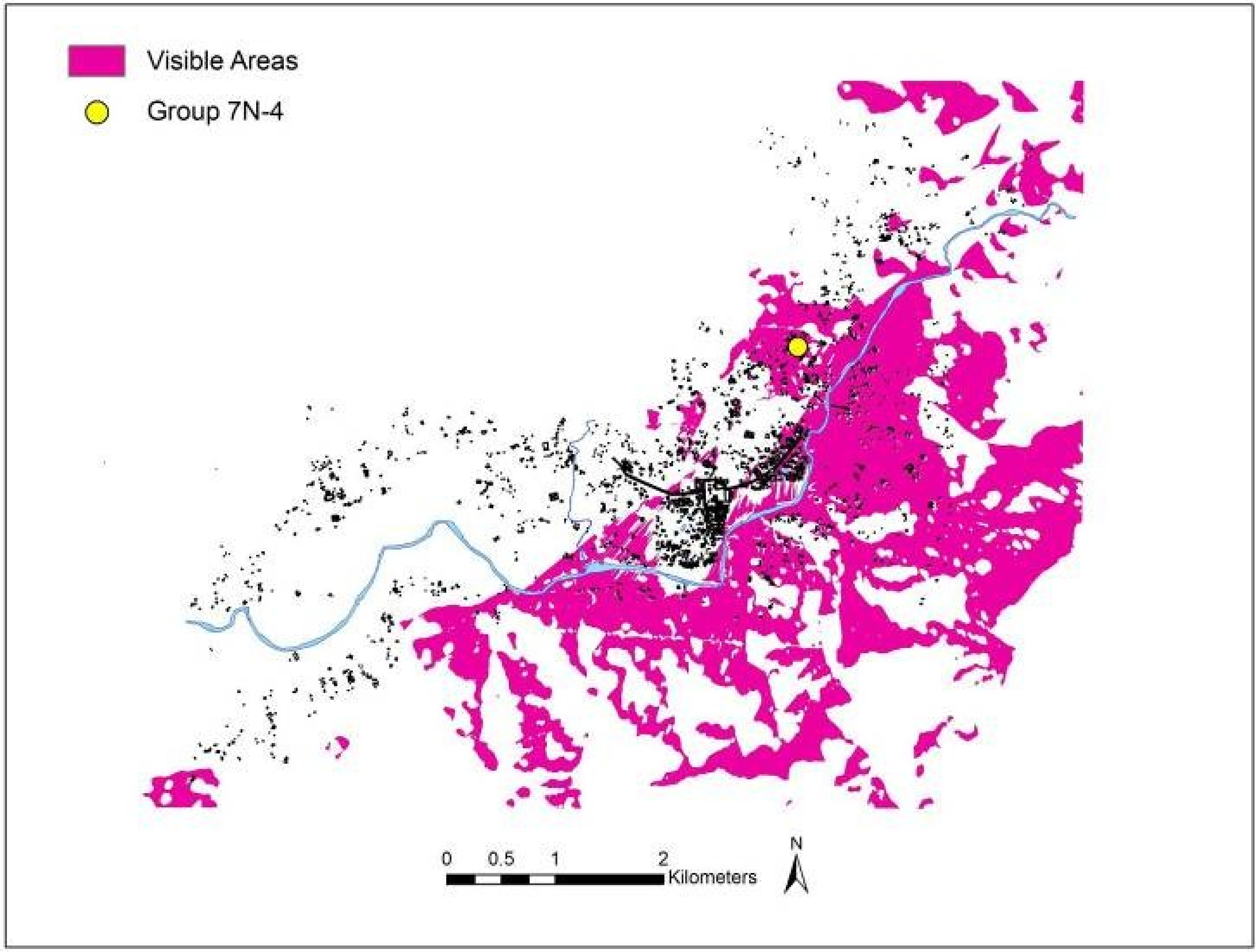
Map H.29: Viewshed of Group 7M-16 (Type 3), Chorro



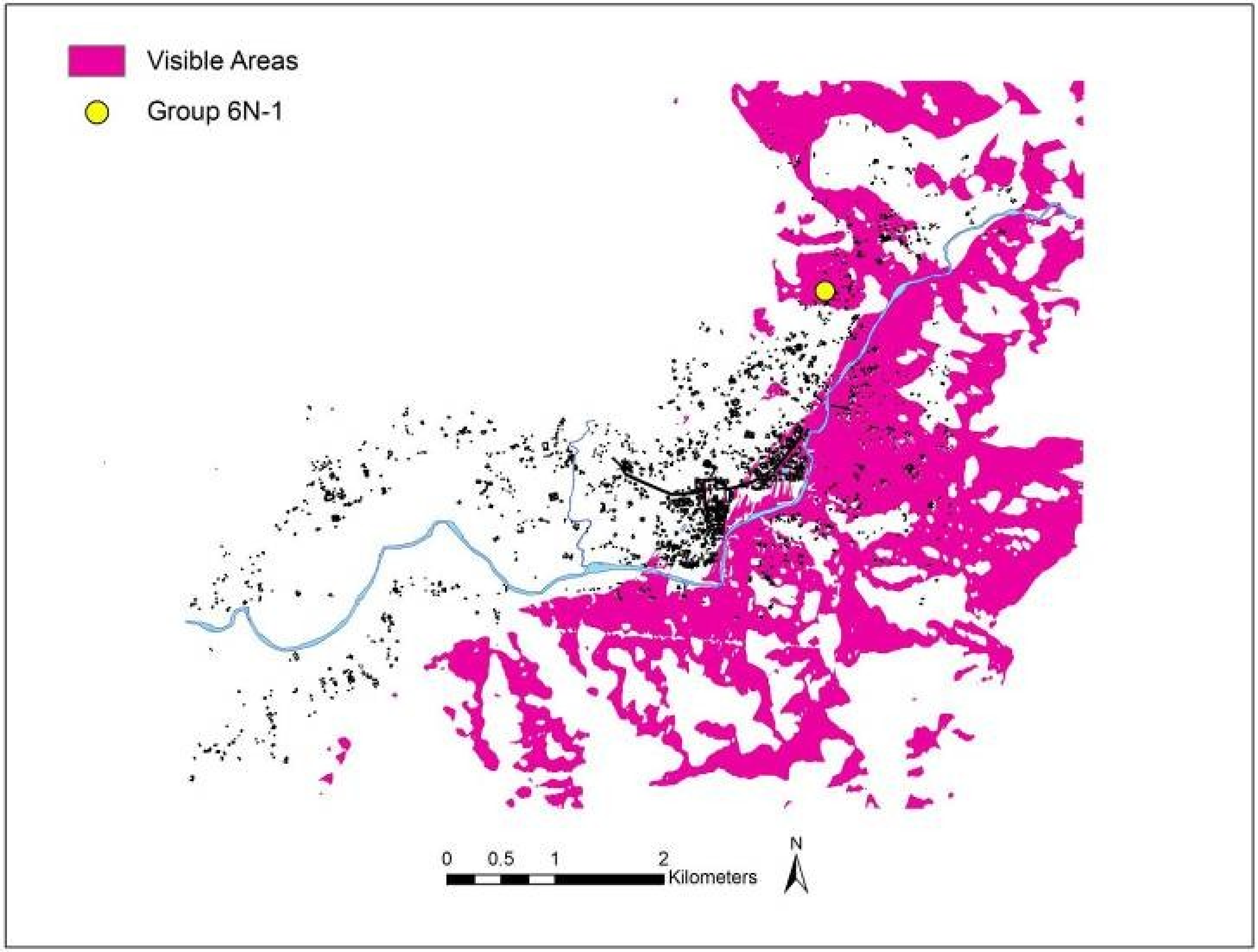
Map H.30: Viewshed of Group 6N-6 (Type 1), Rastrojon



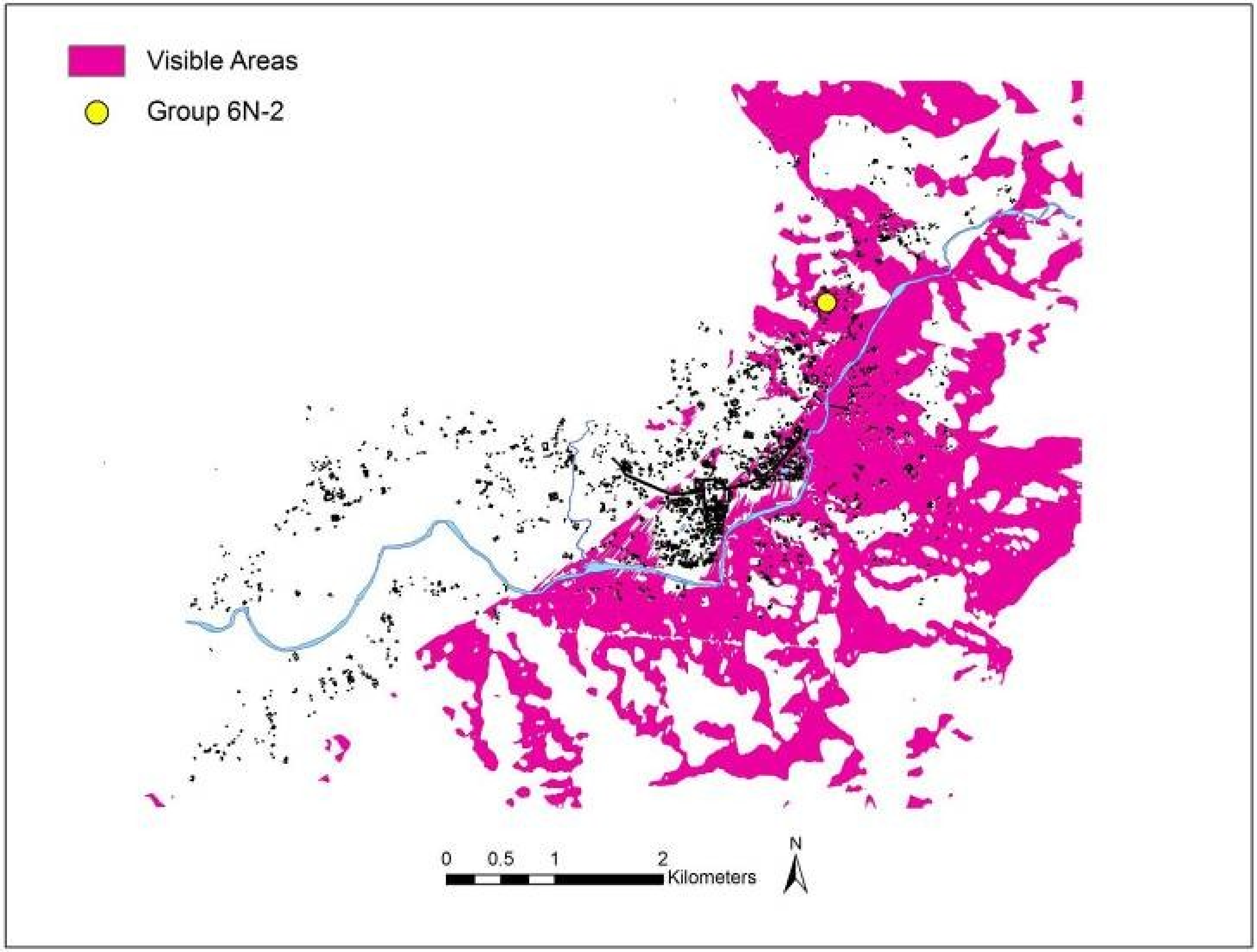
Map H.31: Viewshed of Group 7N-13 (Type 1), Rastrojon



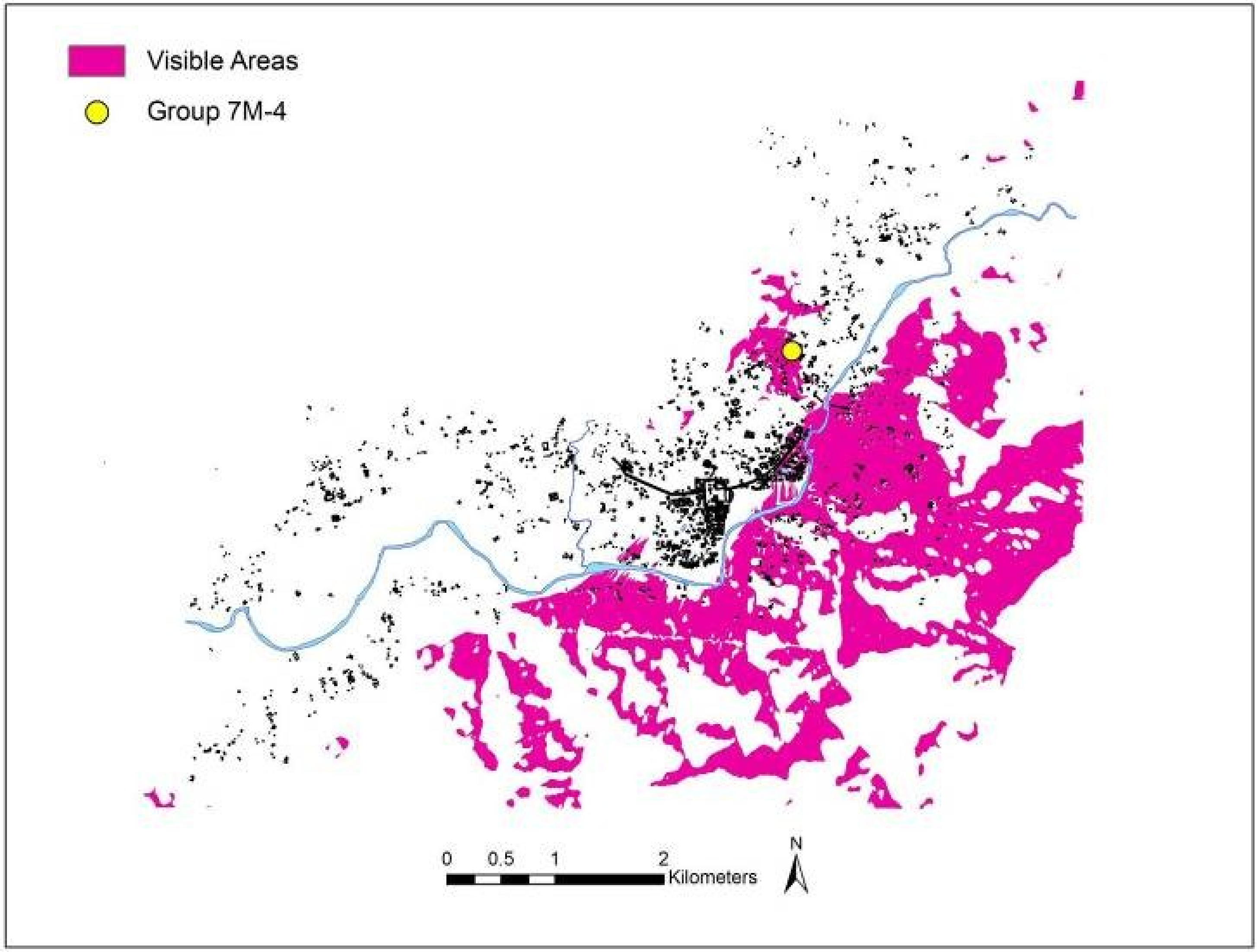
Map H.32: Viewshed of Group 7N-4 (Type 2), Rastrojon



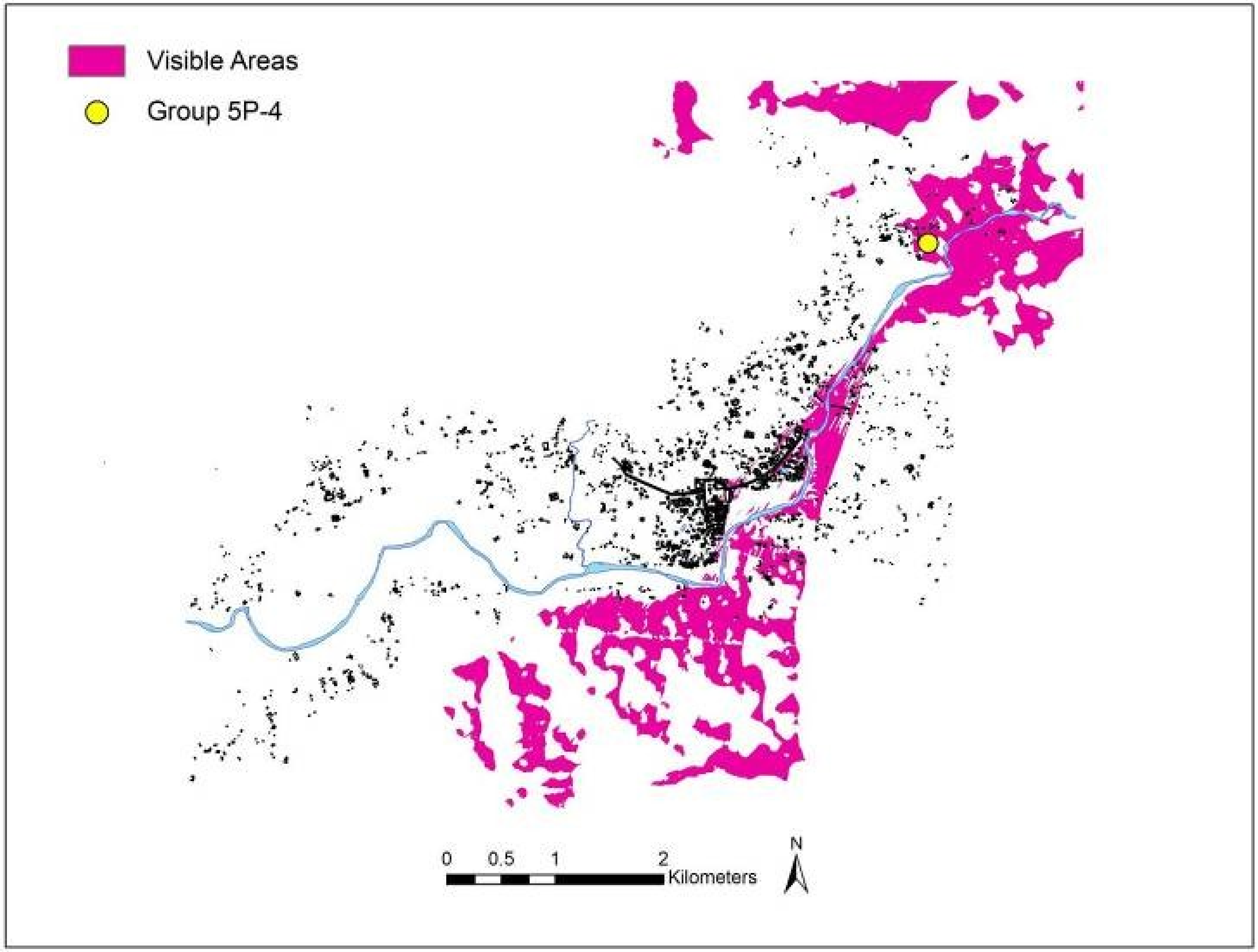
Map H.33: Viewshed of Group 6N-1 (Type 2), Rastrojon



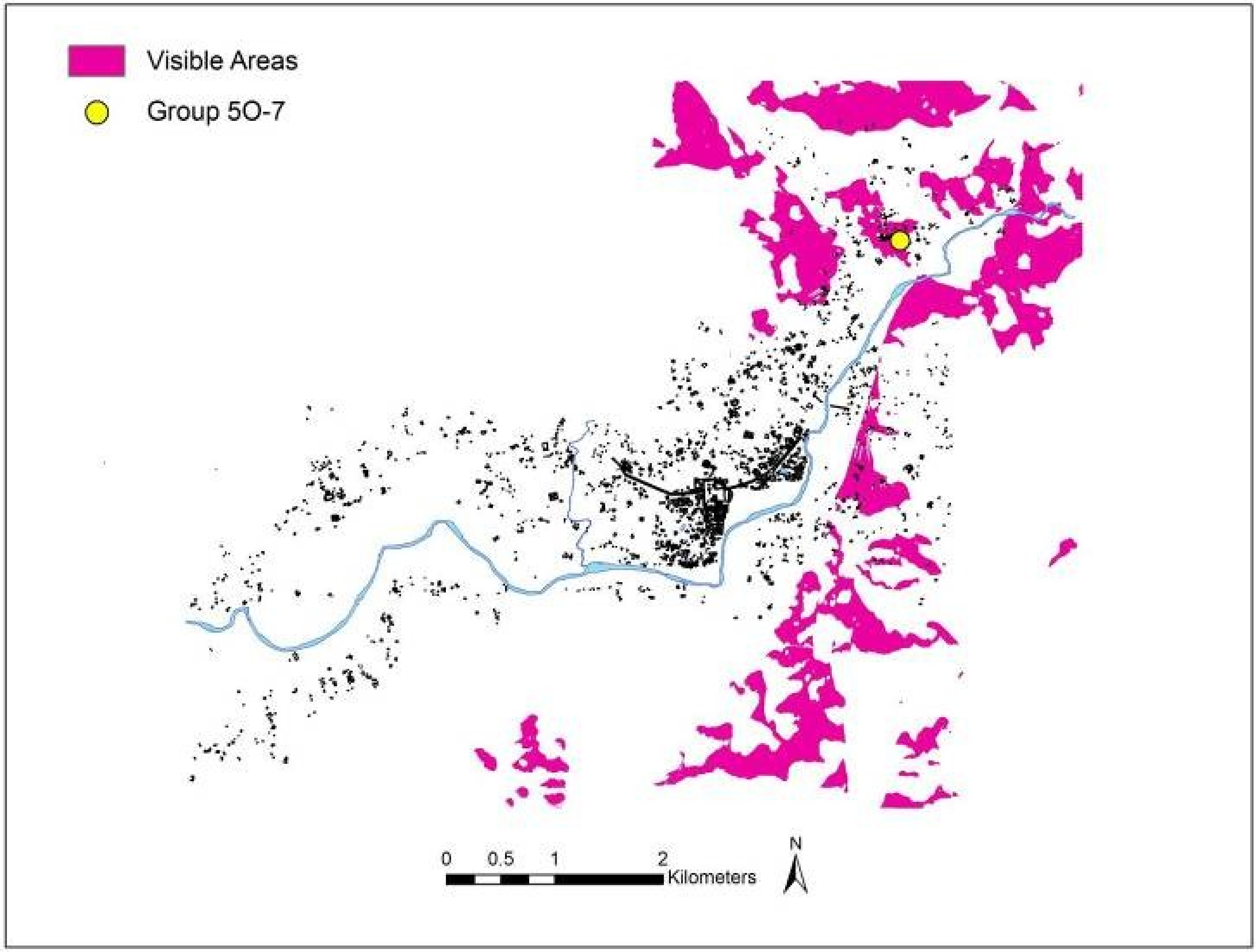
Map H.34: Viewshed of Group 6N-2 (Type 2), Rastrojon



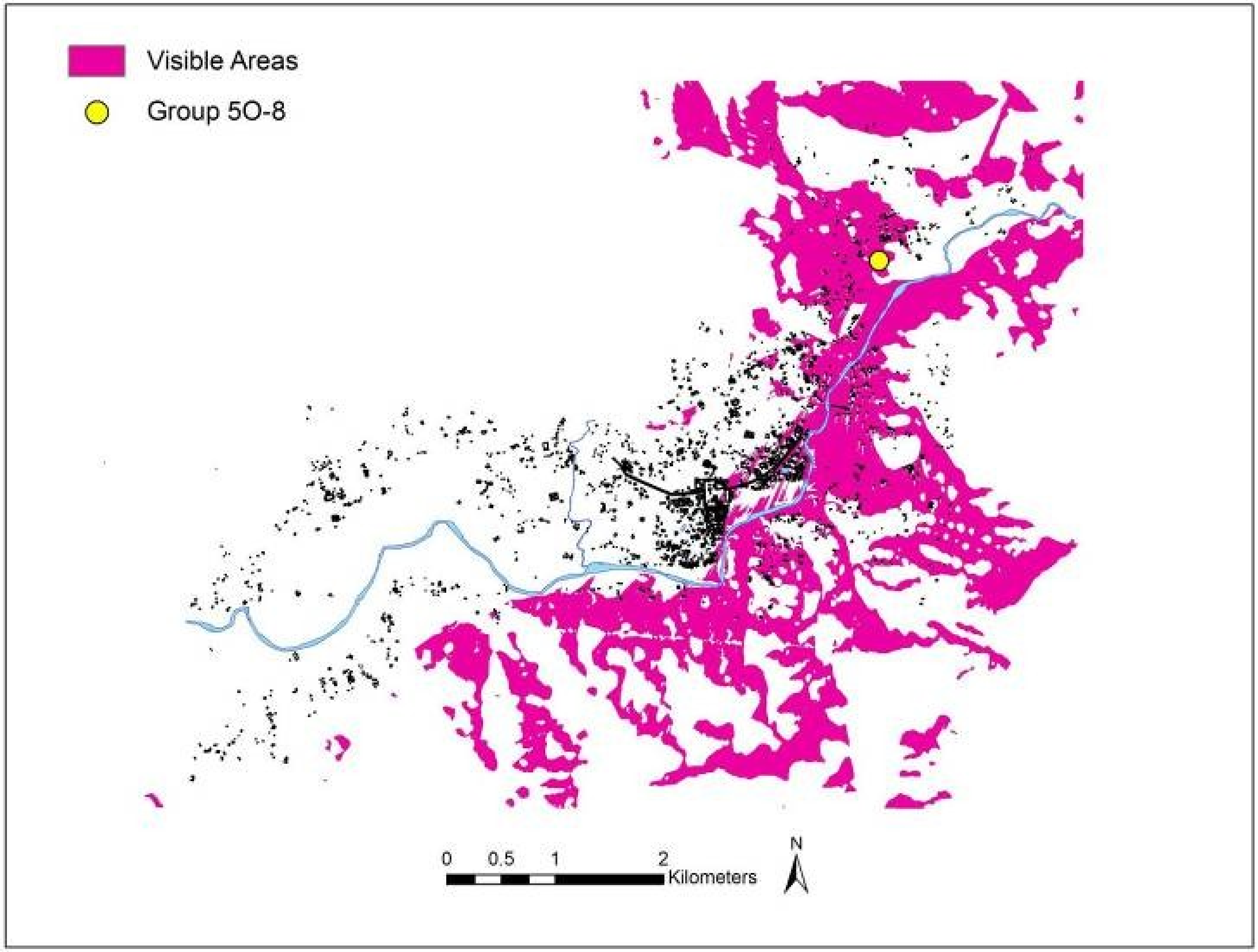
Map H.35: Viewshed of Group 7M-4 (Type 3), Rastrojon



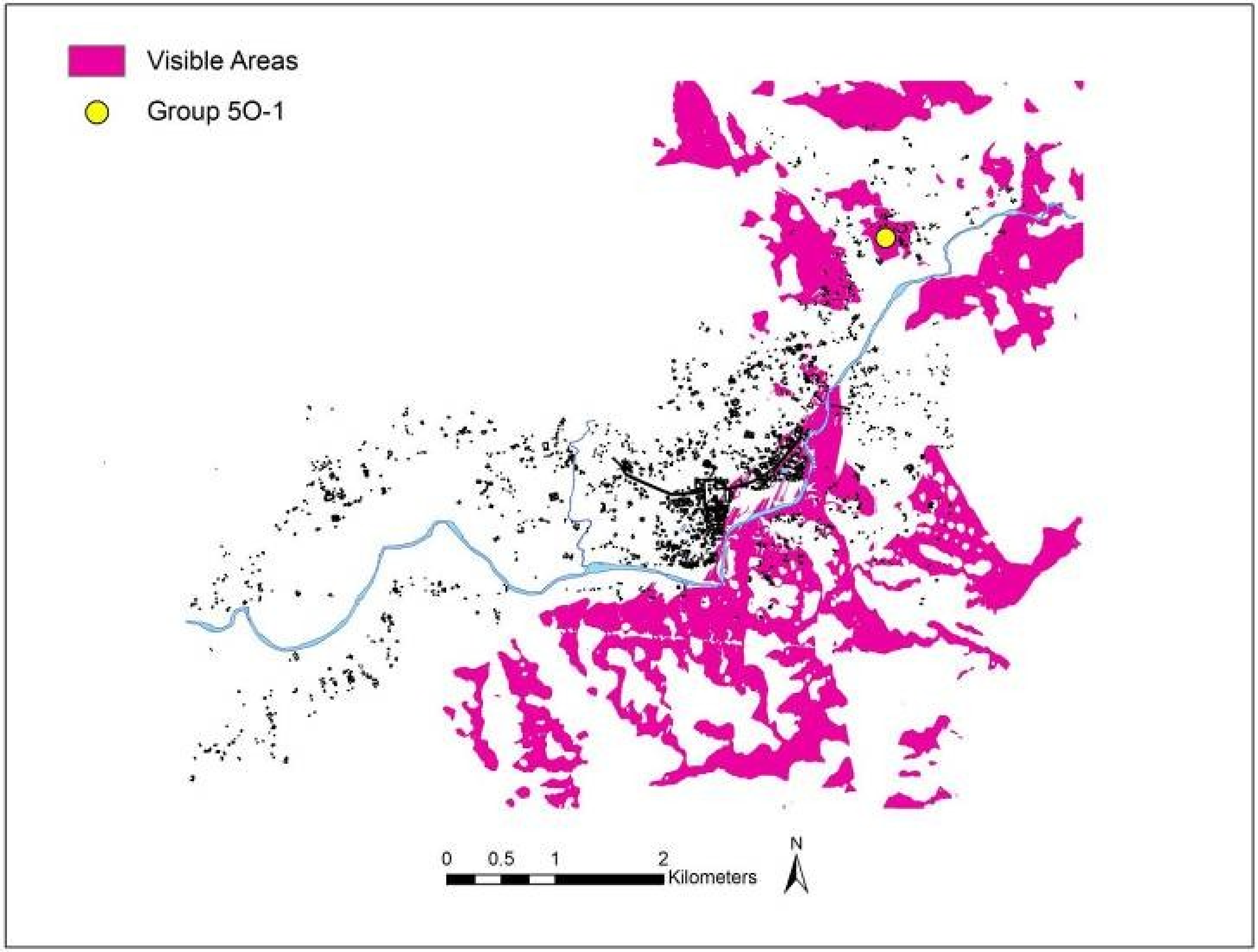
Map H.36: Viewshed of Group 5P-4 (Type 1), Mesa de Petapilla



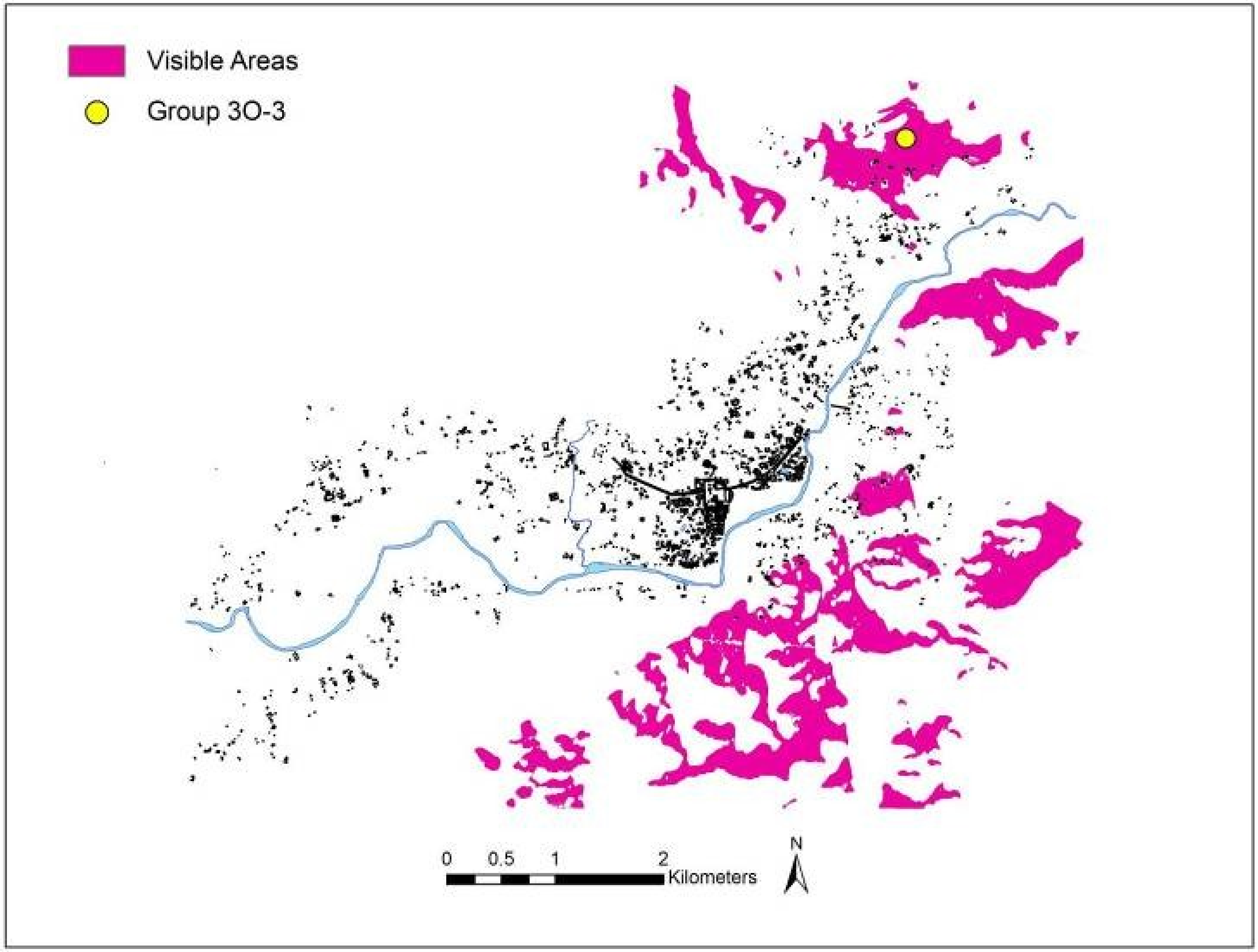
Map H.37: Viewshed of Group 5O-7 (Type 2), Mesa de Petapilla



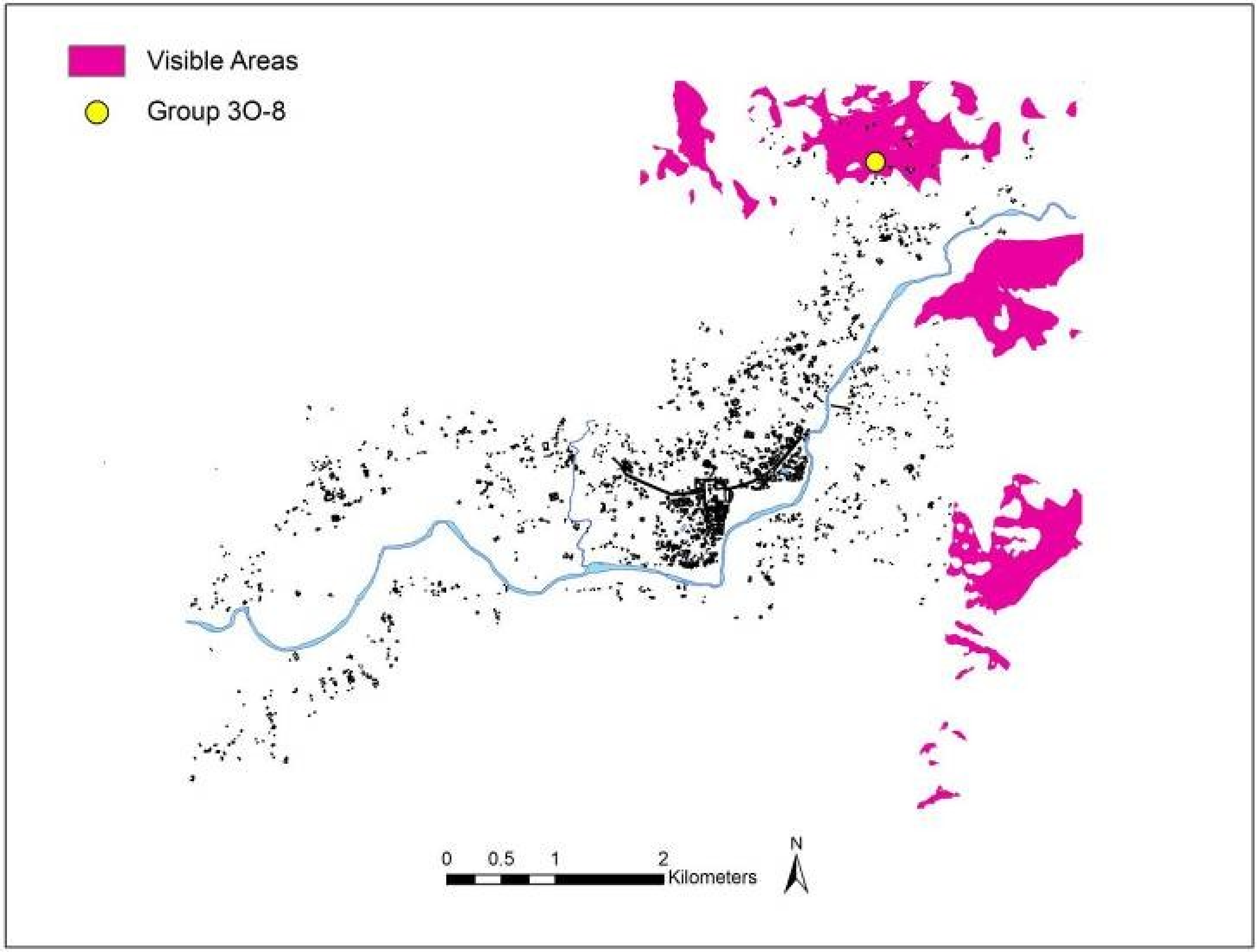
Map H.38: Viewshed of Group 5O-8 (Type 3), Mesa de Petapilla



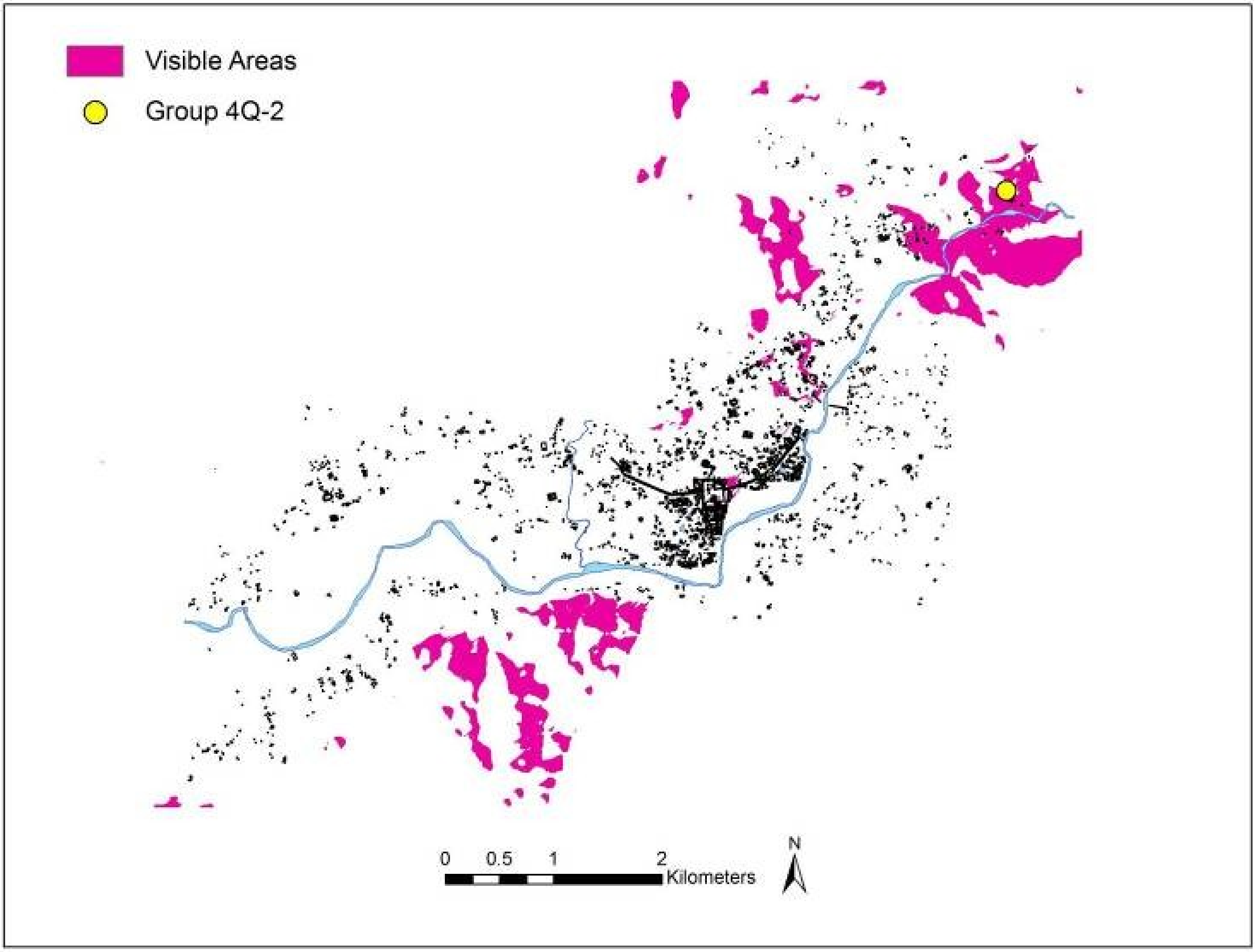
Map H.39: Viewshed of Group 5O-1 (Type 3), Mesa de Petapilla



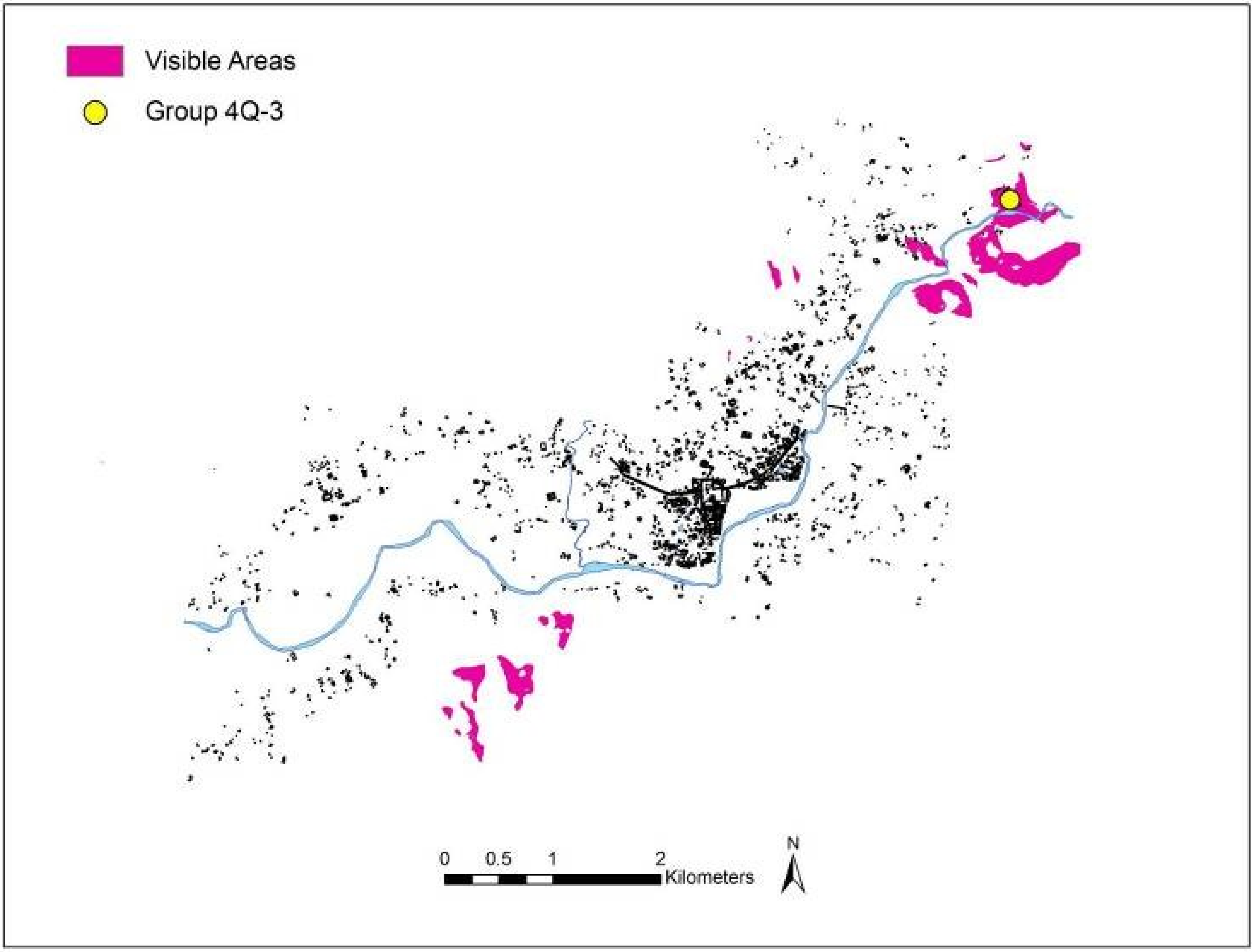
Map H.40: Viewshed of Group 3O-3 (Type 1), Bolsa de Petapilla



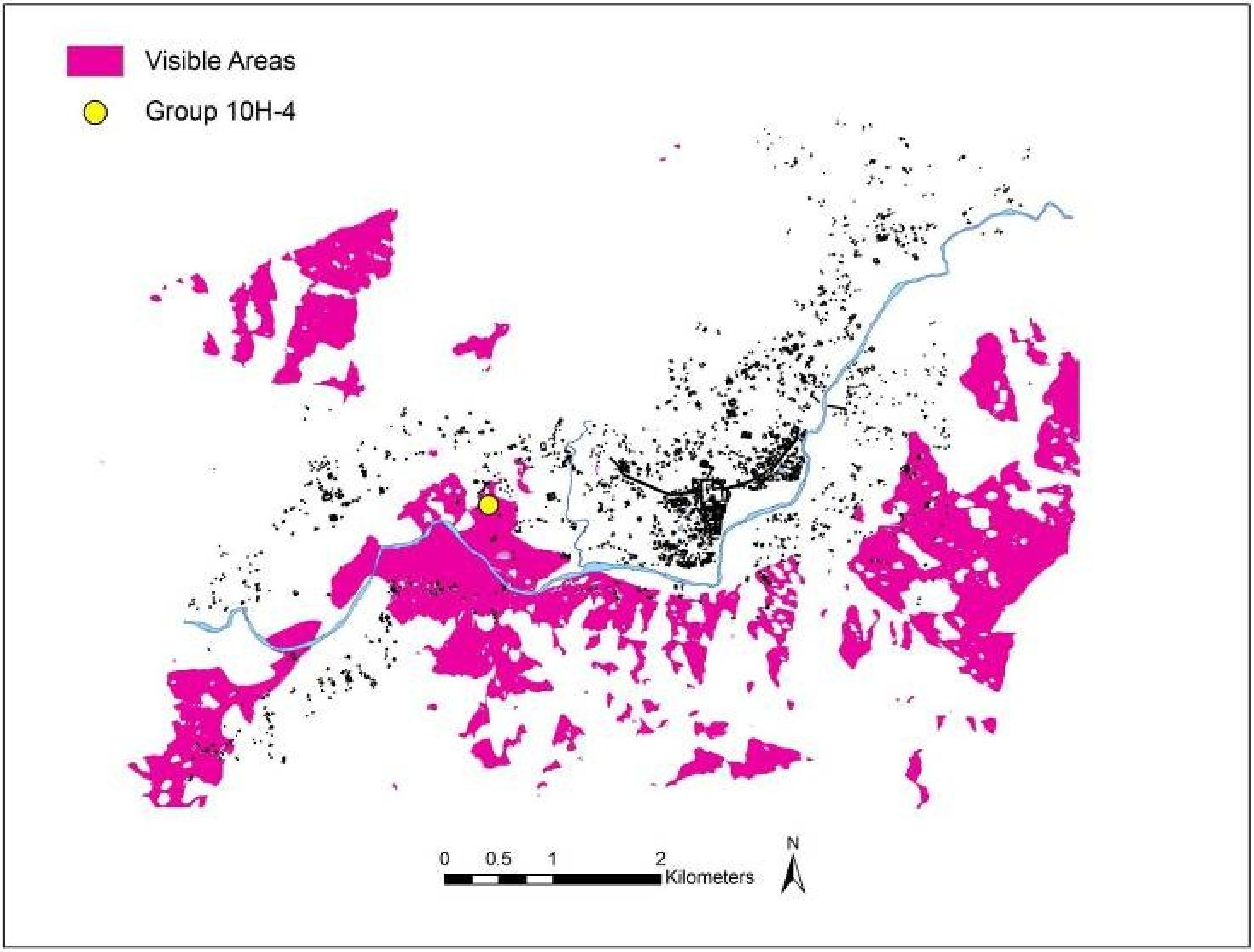
Map H.41: Viewshed of Group 3O-8 (Type 2), Bolsa de Petapilla



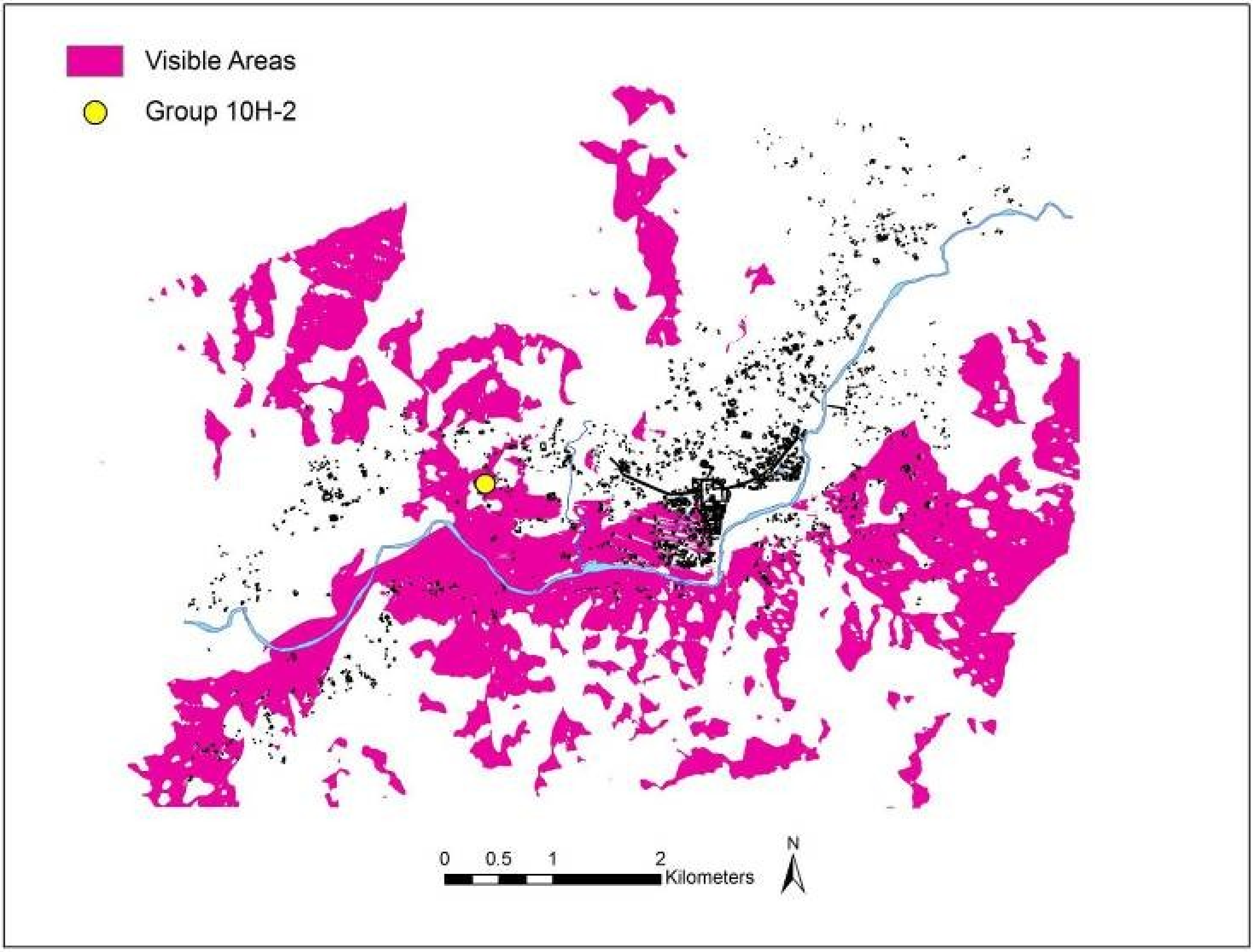
Map H.42: Viewshed of Group 4Q-2 (Type 1), Titoror



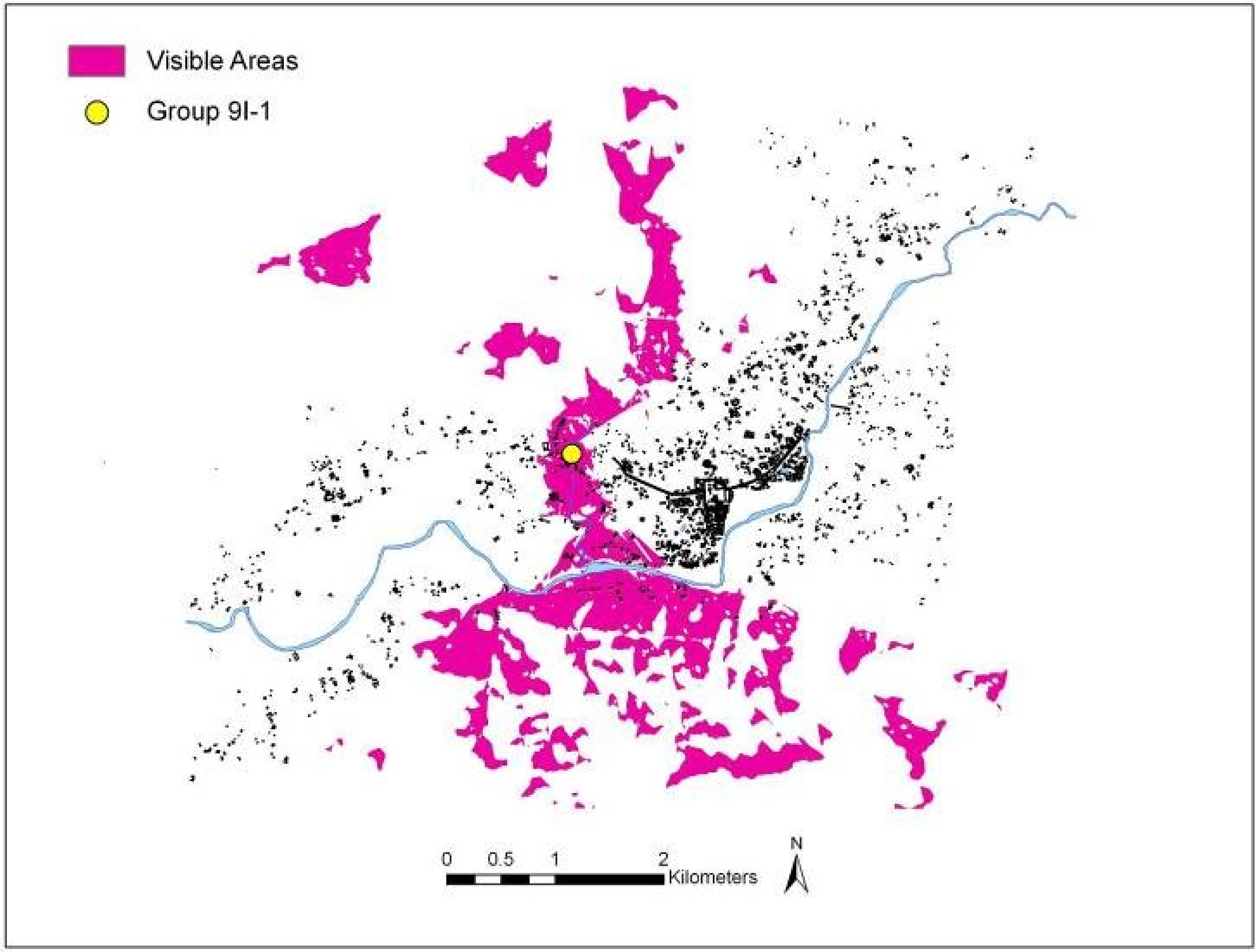
Map H.43: Viewshed of Group 4Q-3 (Type 1), Titoror



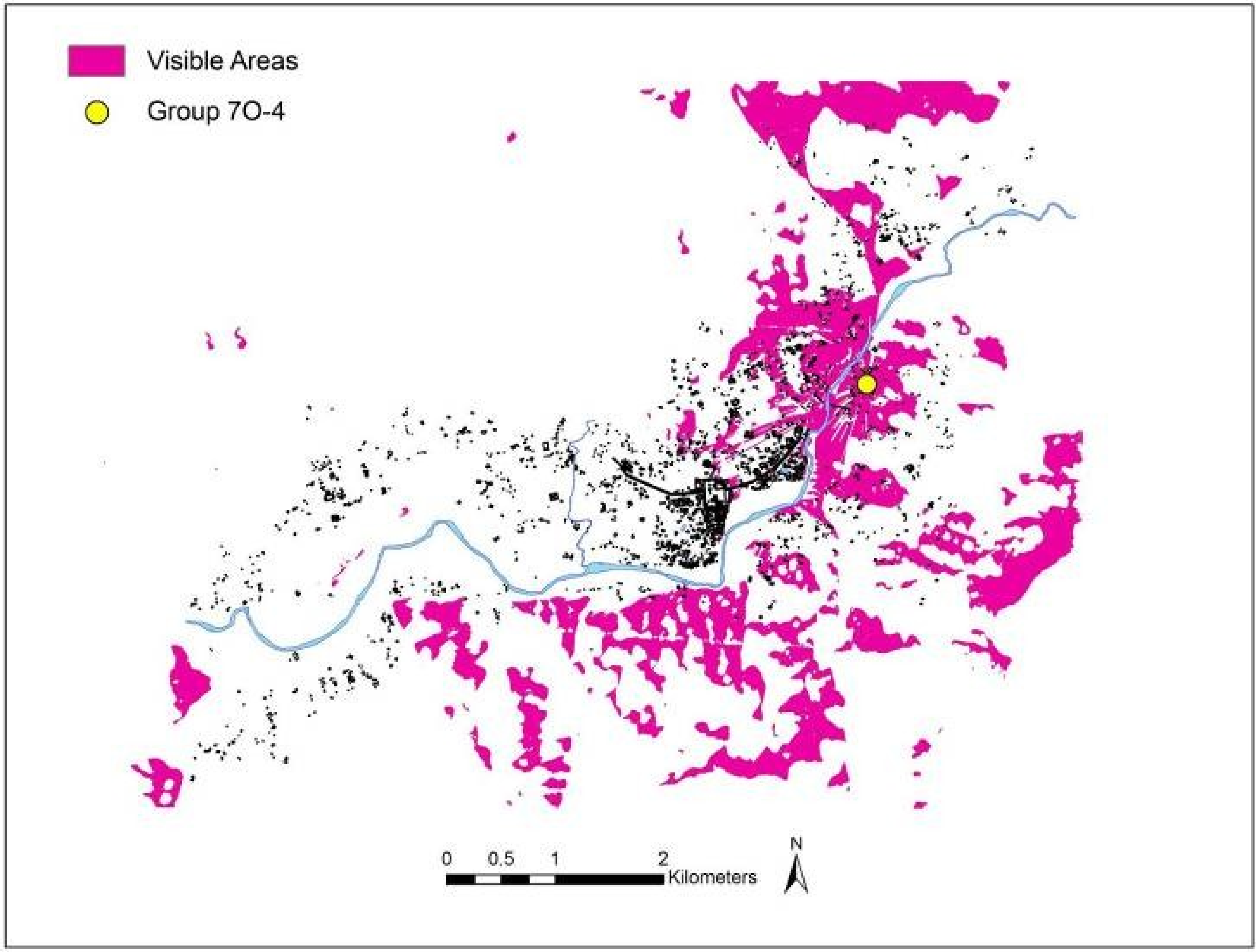
Map H.44: Viewshed of Group 10H-4 (Type 1), El Pueblo



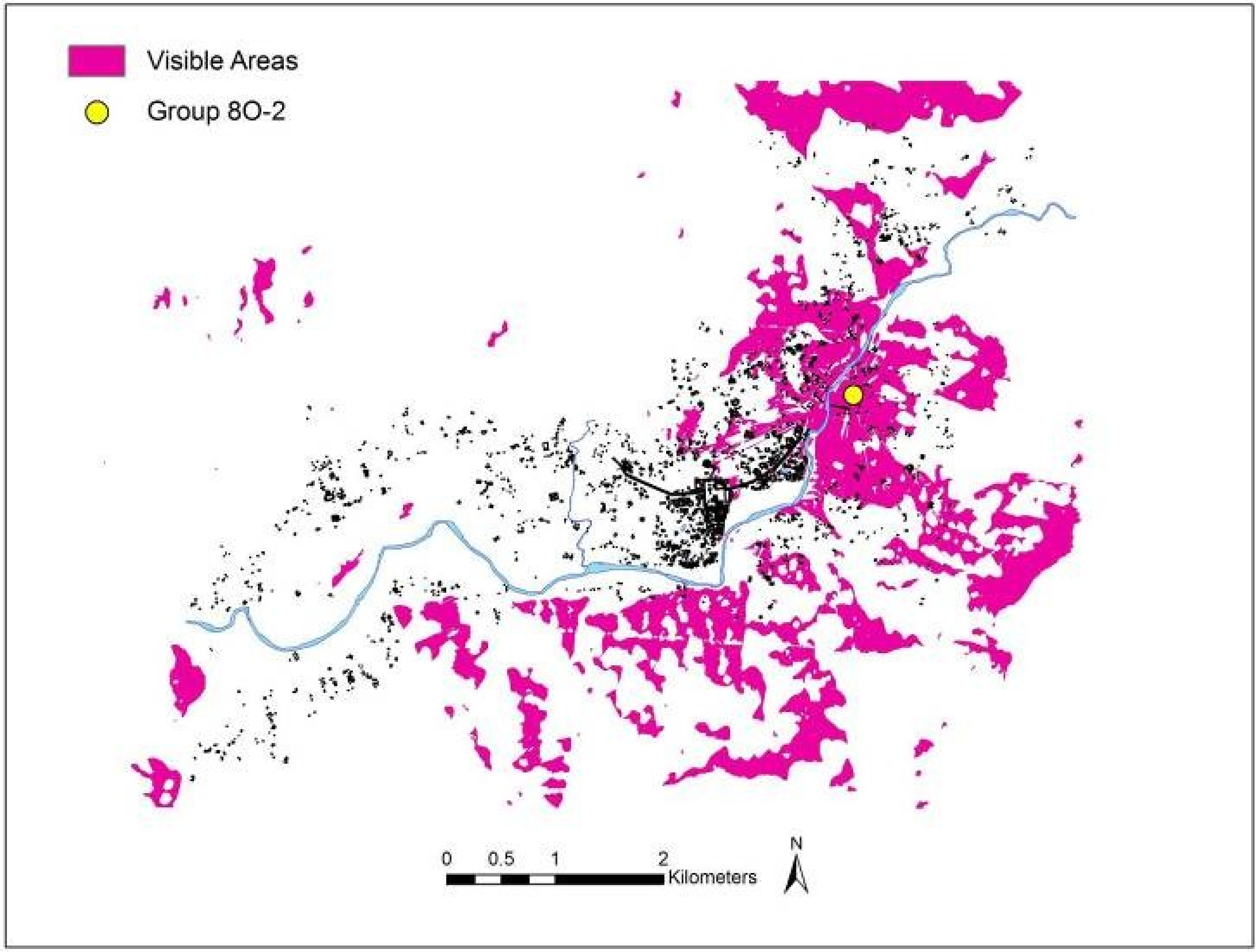
Map H.45: Viewshed of Group 10H-2 (Type 2), El Pueblo



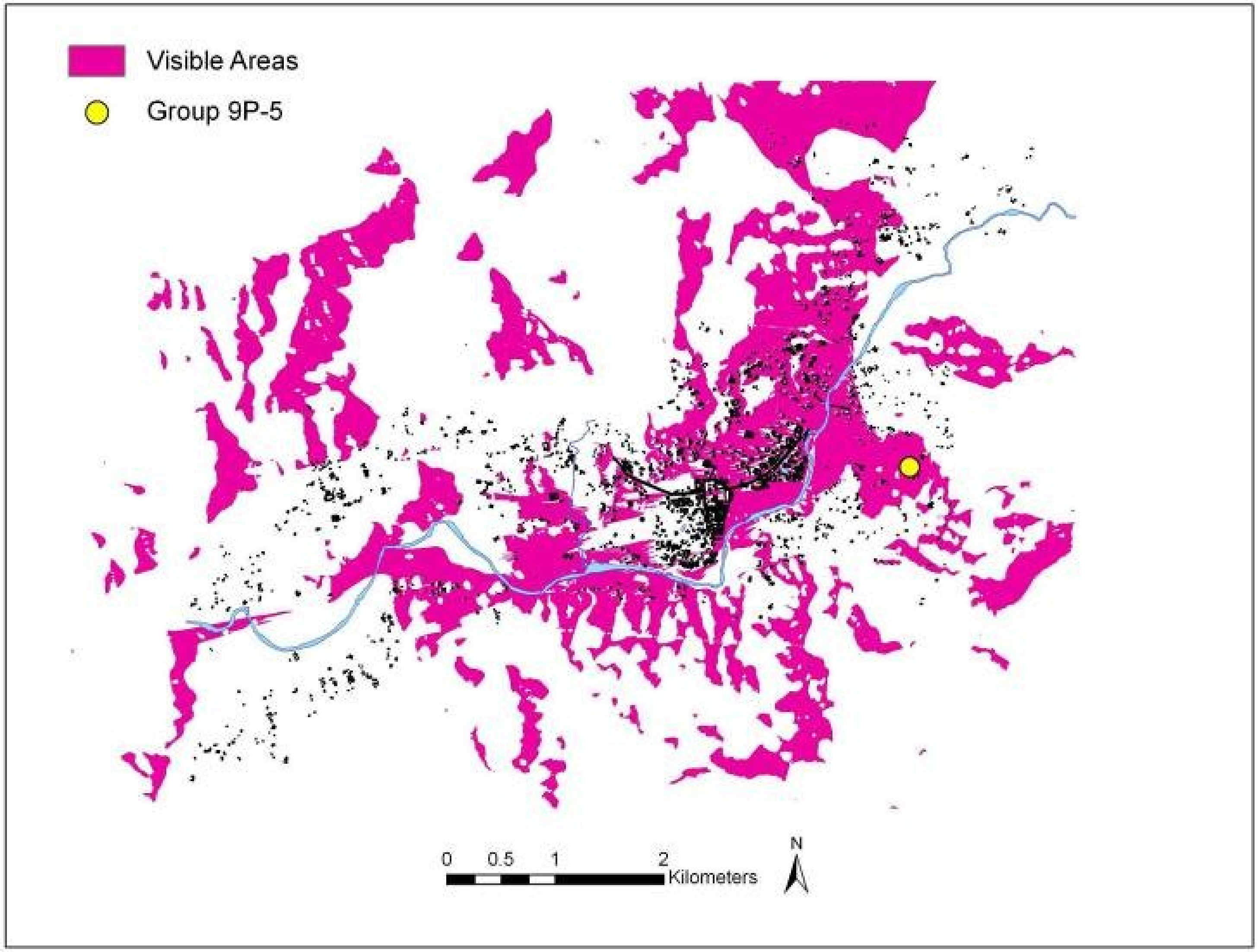
Map H.46: Viewshed of Group 9I-1 (Type 4), El Pueblo



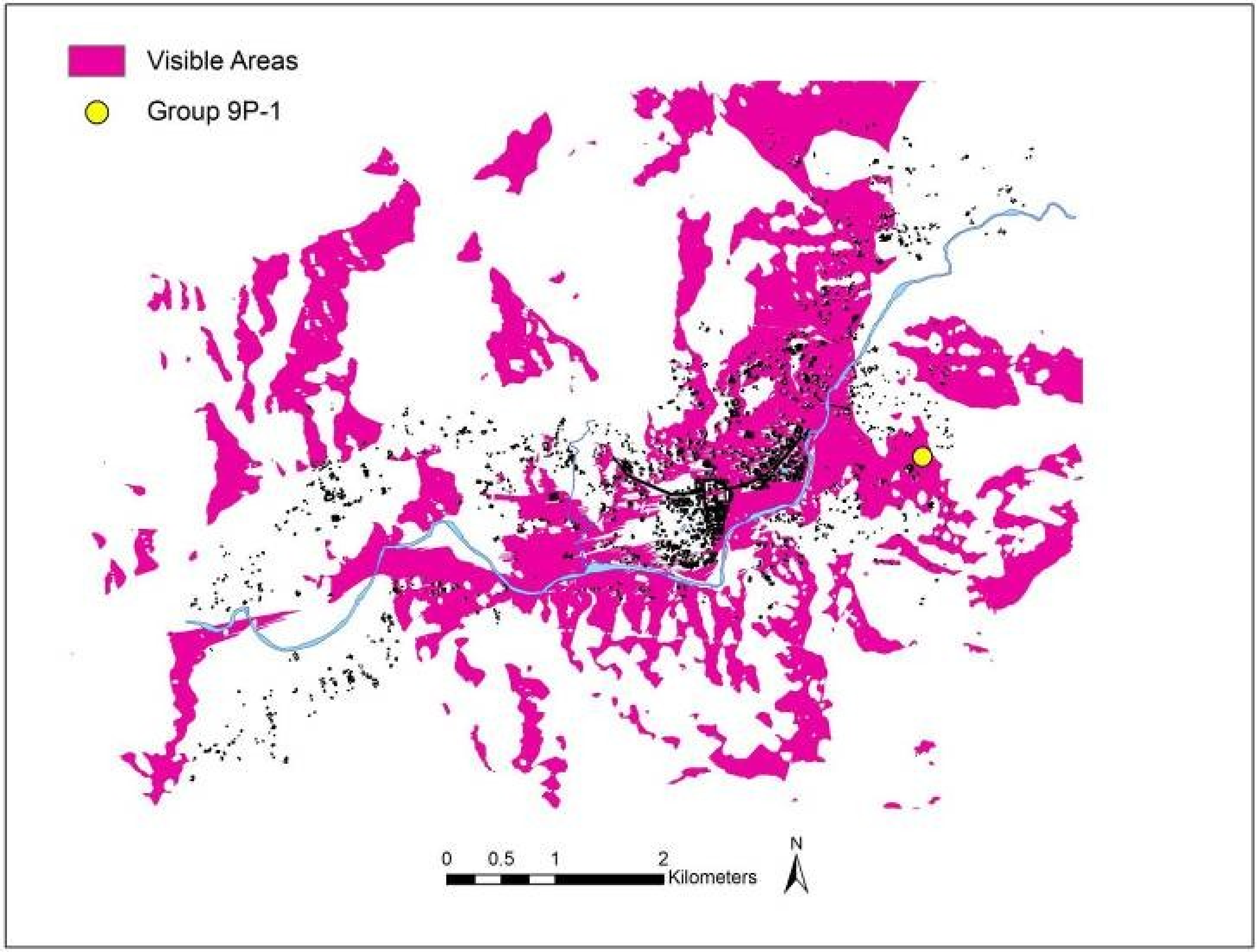
Map H.47: Viewshed of Group 7O-4 (Type 1), Titichon



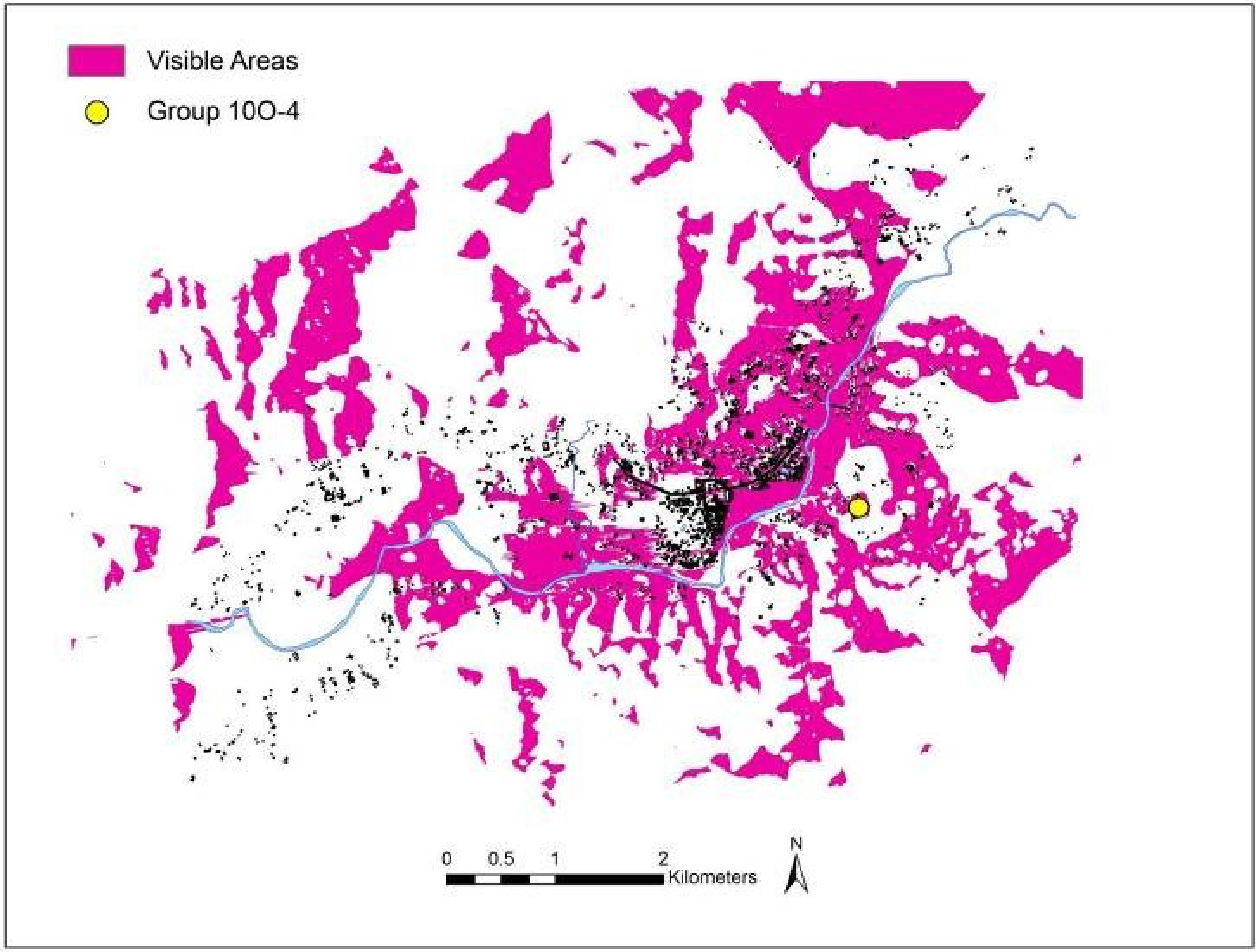
Map H.48: Viewshed of Group 8O-2 (Type 2), Titichon



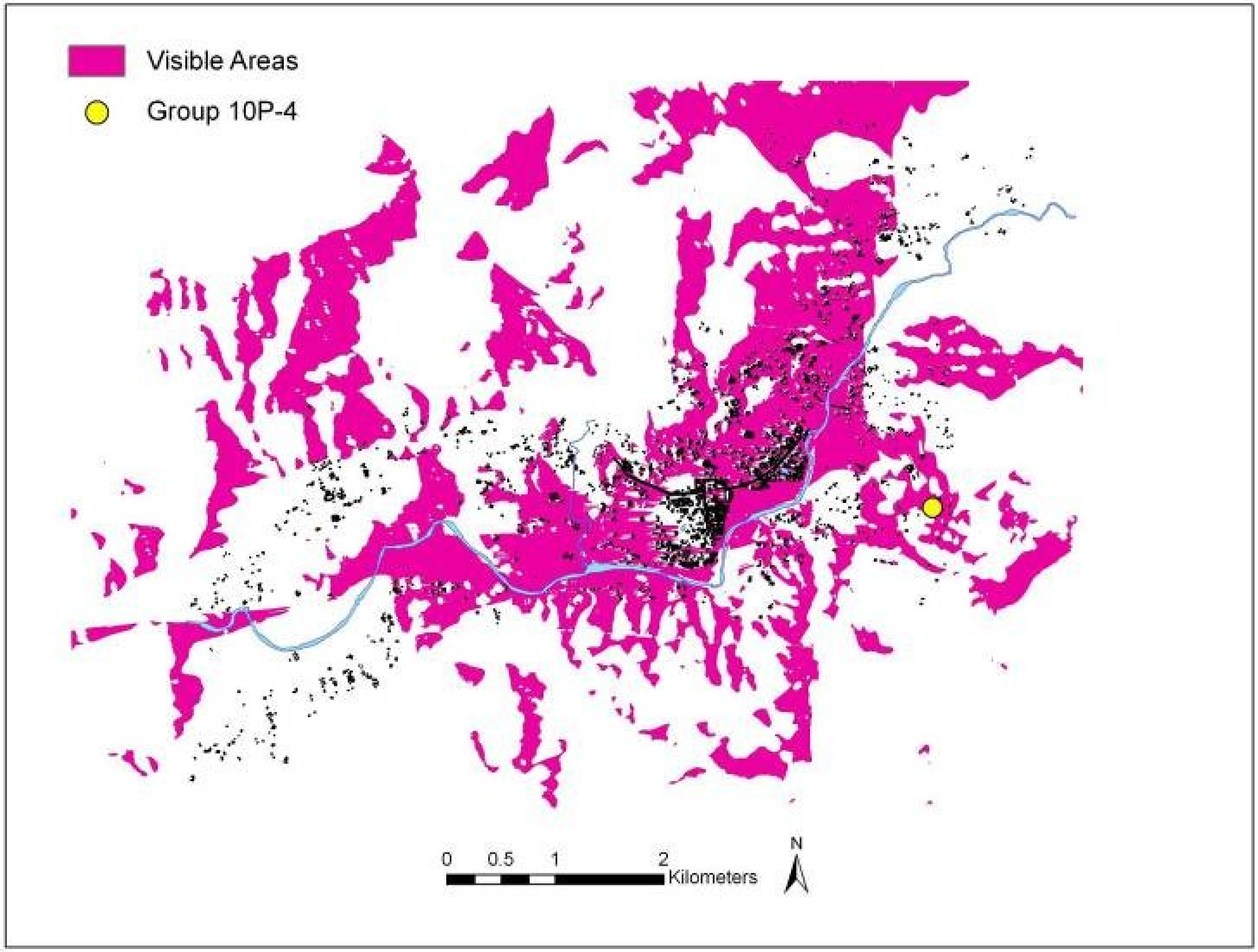
Map H.49: Viewshed of Group 9P-5 (Type 2), Titichon



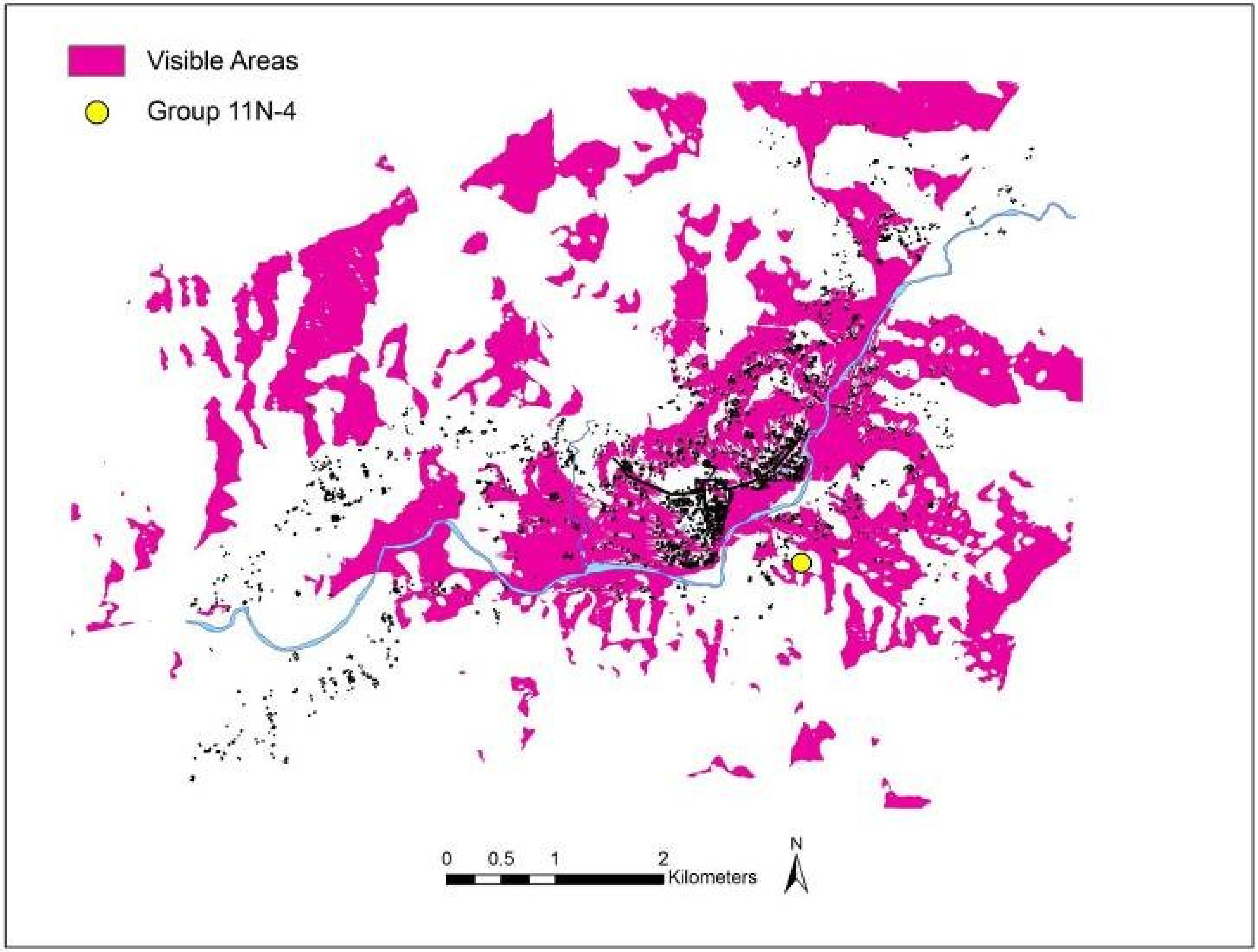
Map H.50: Viewshed of Group 9P-1 (Type 2), Titichon



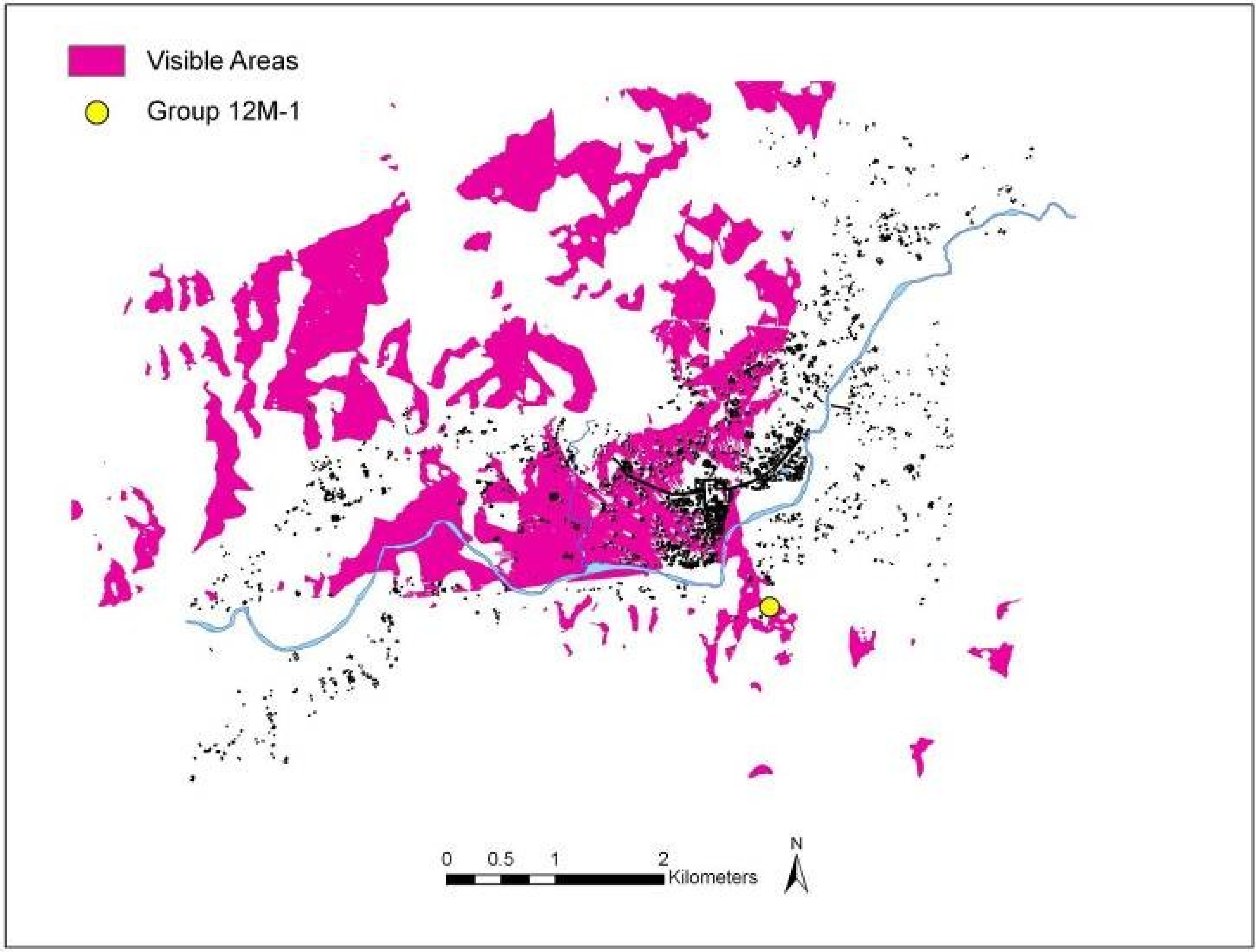
Map H.51: Viewshed of Group 10O-4 (Type 1), San Rafael



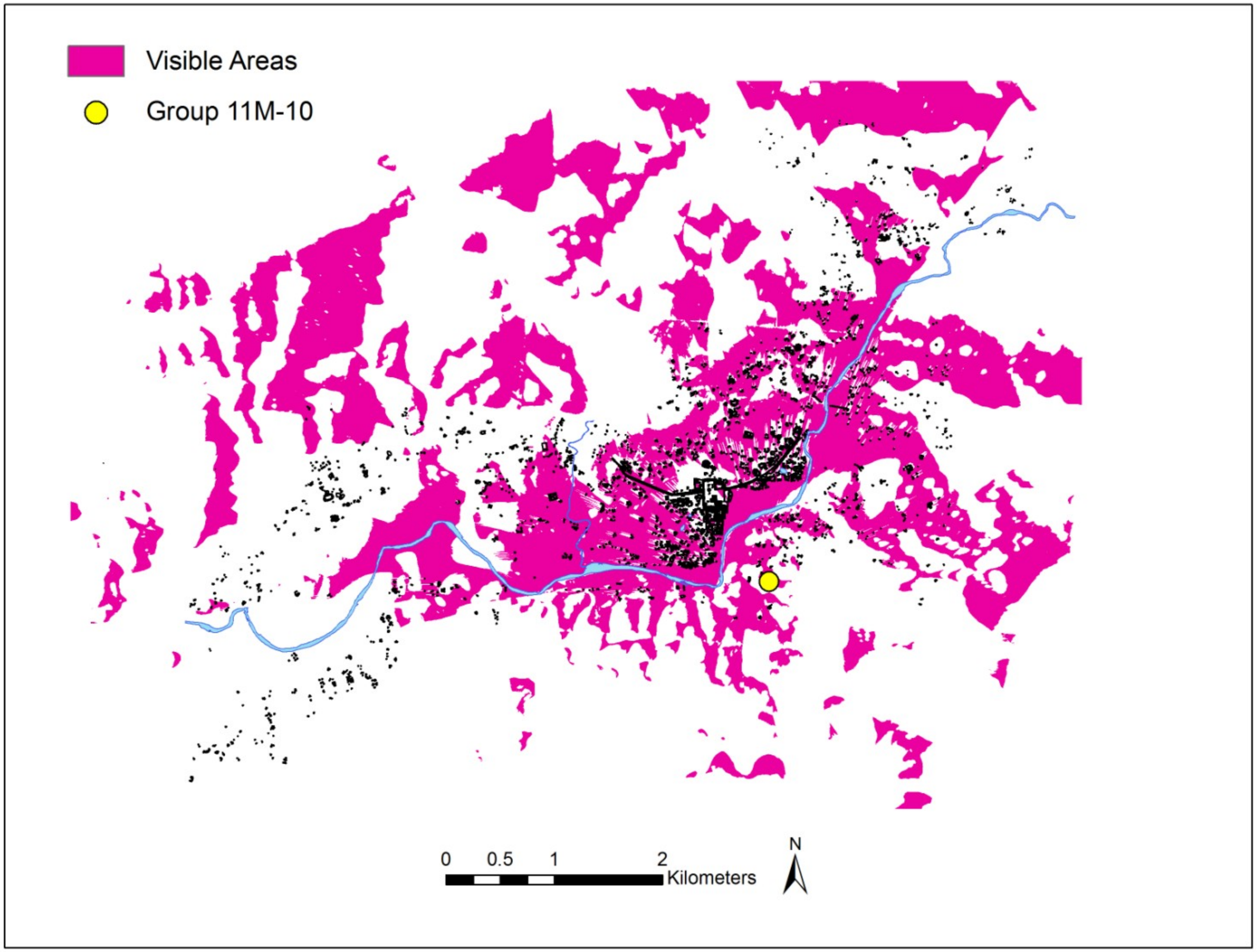
Map H.52: Viewshed of Group 10P-4 (Type 2), San Rafael



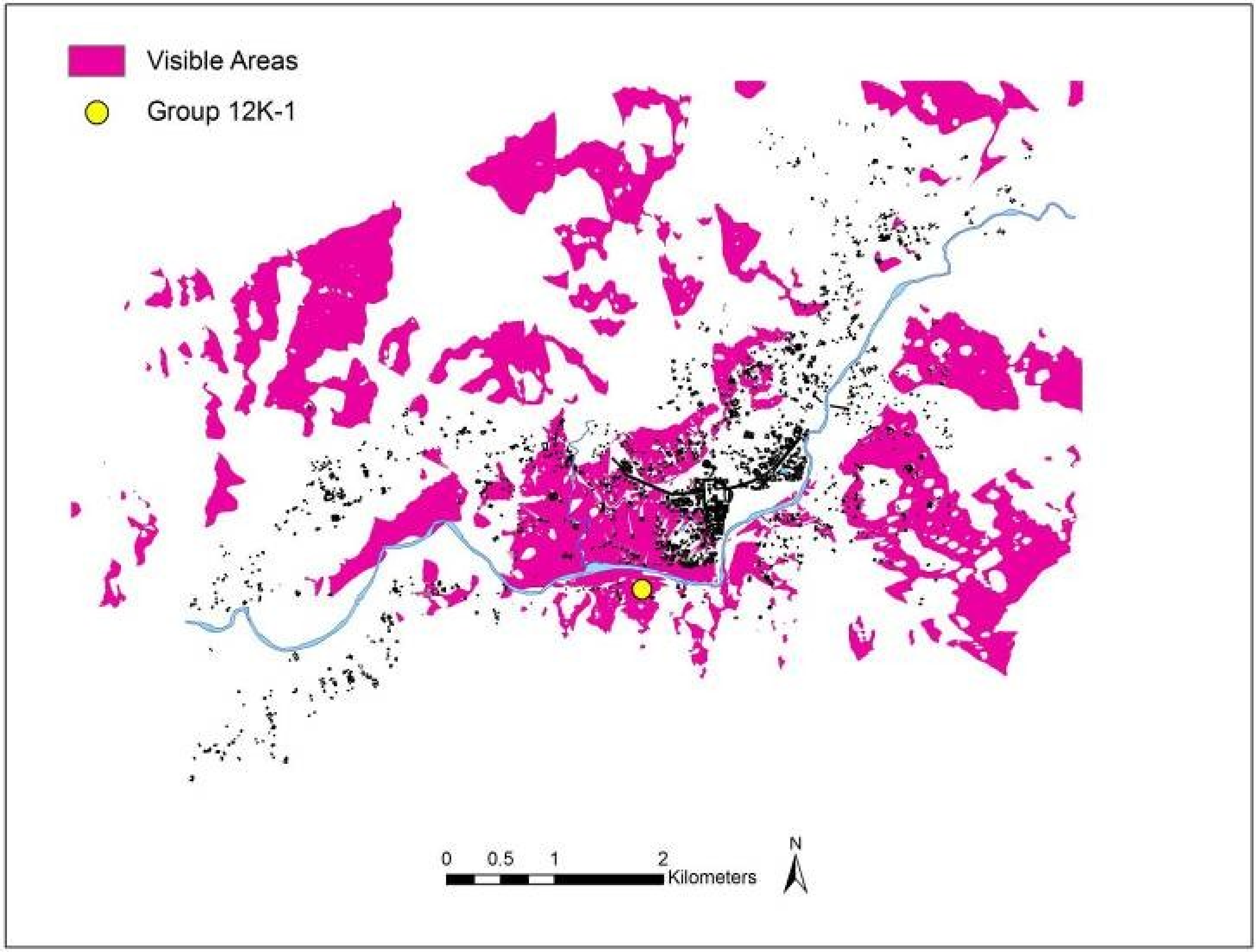
Map H.53: Viewshed of Group 11N-4 (Type 1), San Lucas



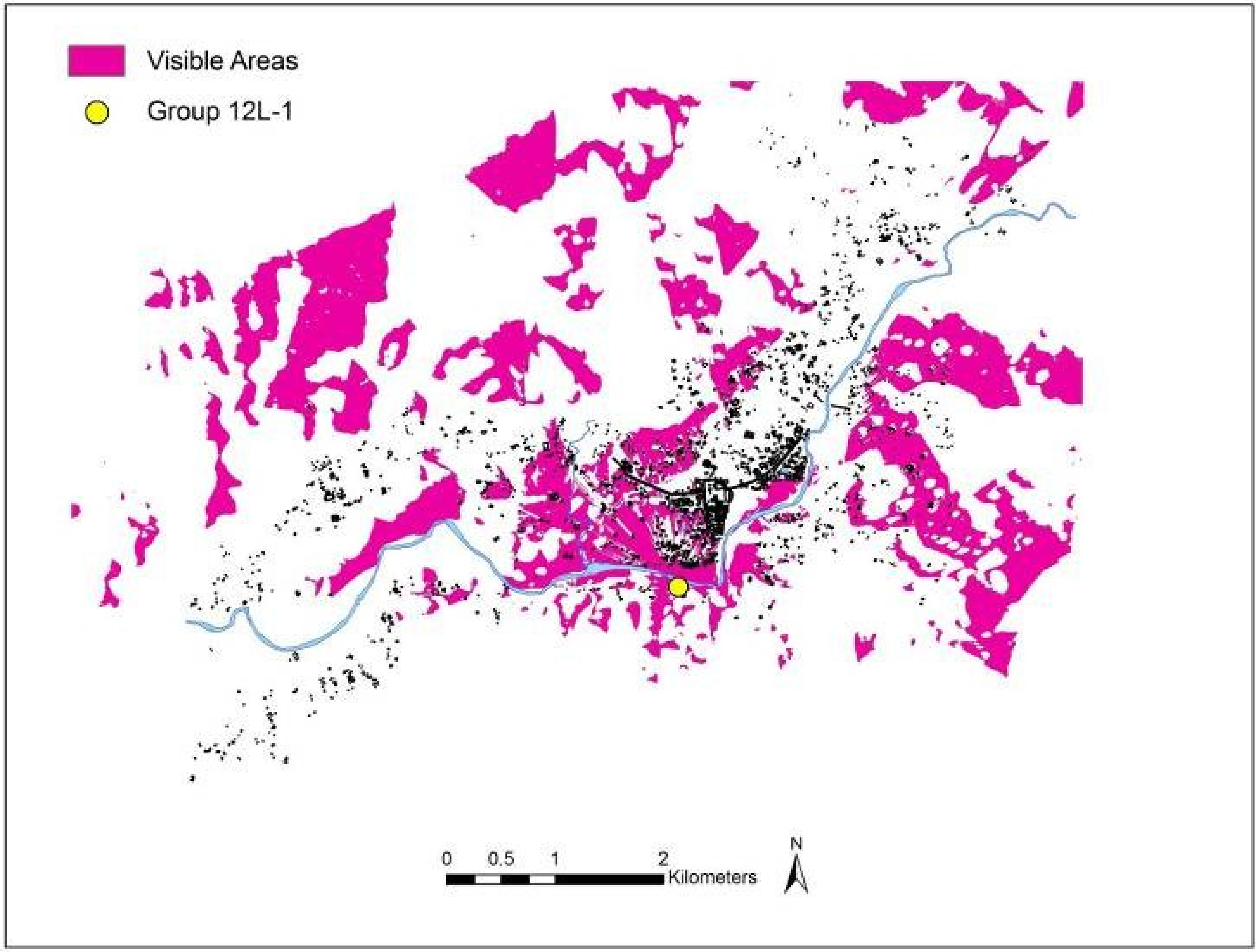
Map H.54: Viewshed of Group 12M-1 (Type 1), San Lucas



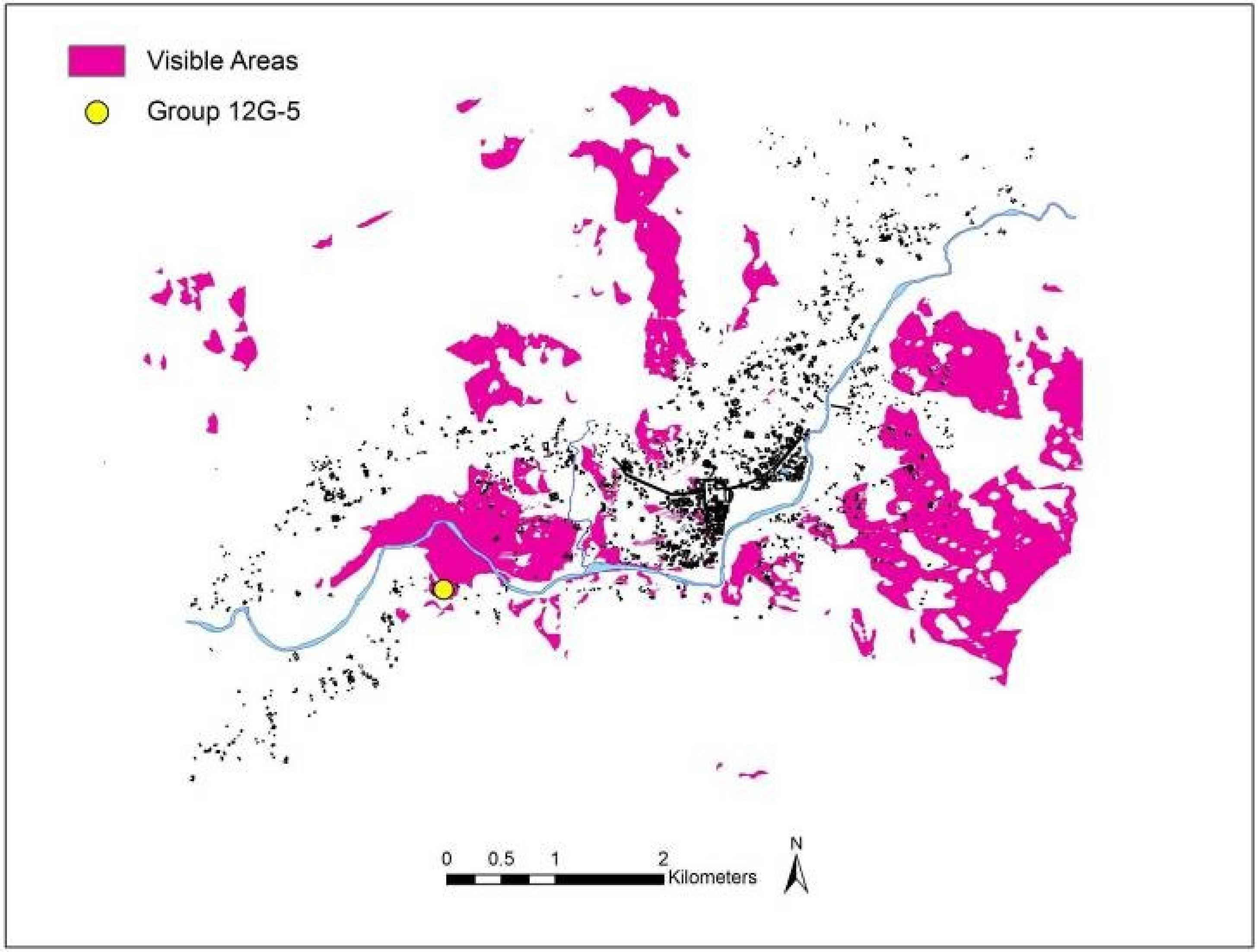
Map H.55: Viewshed of Group 11M-10 (Type 2), San Lucas



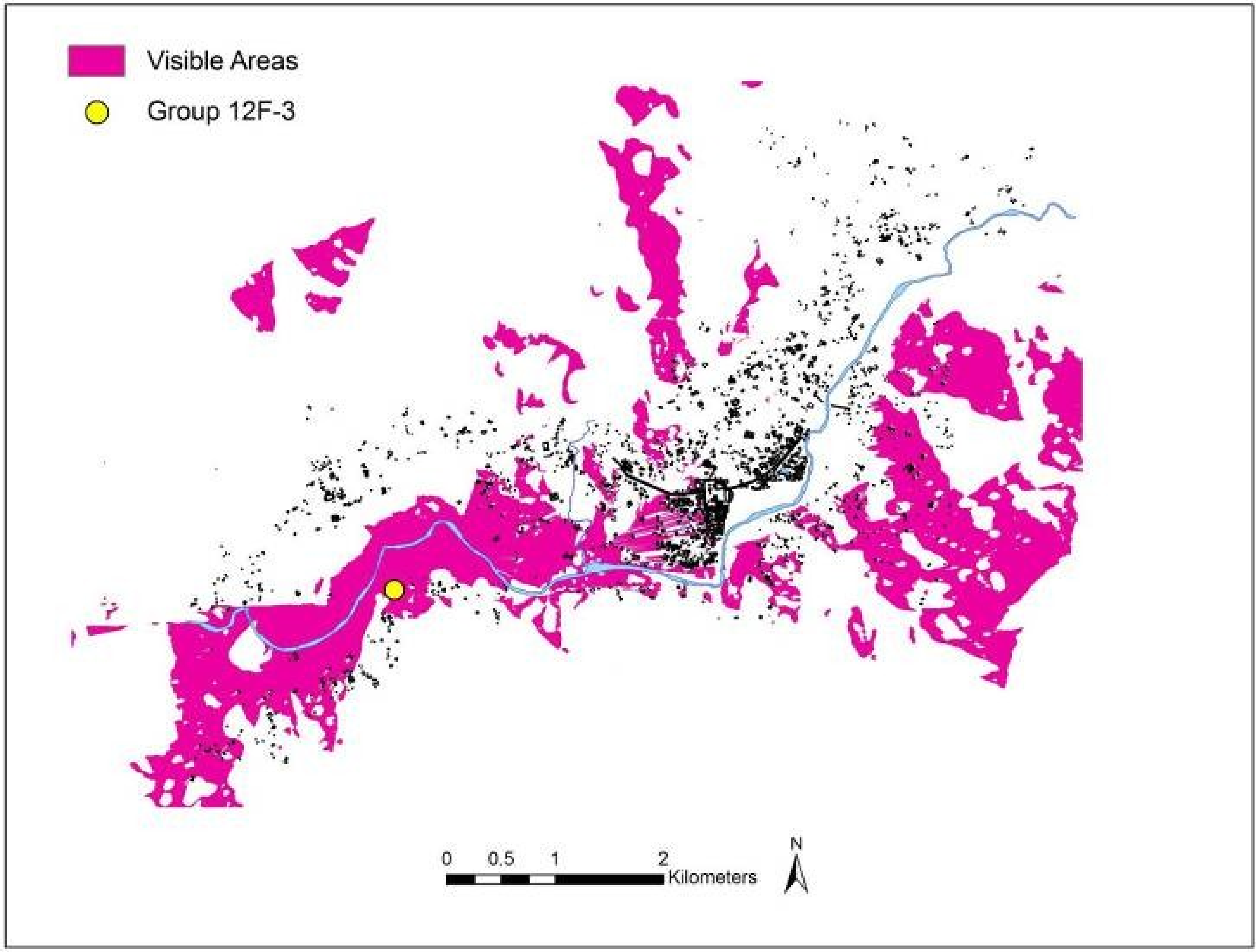
Map H.56: Viewshed of Group 12K-1 (Type 1), El Puente



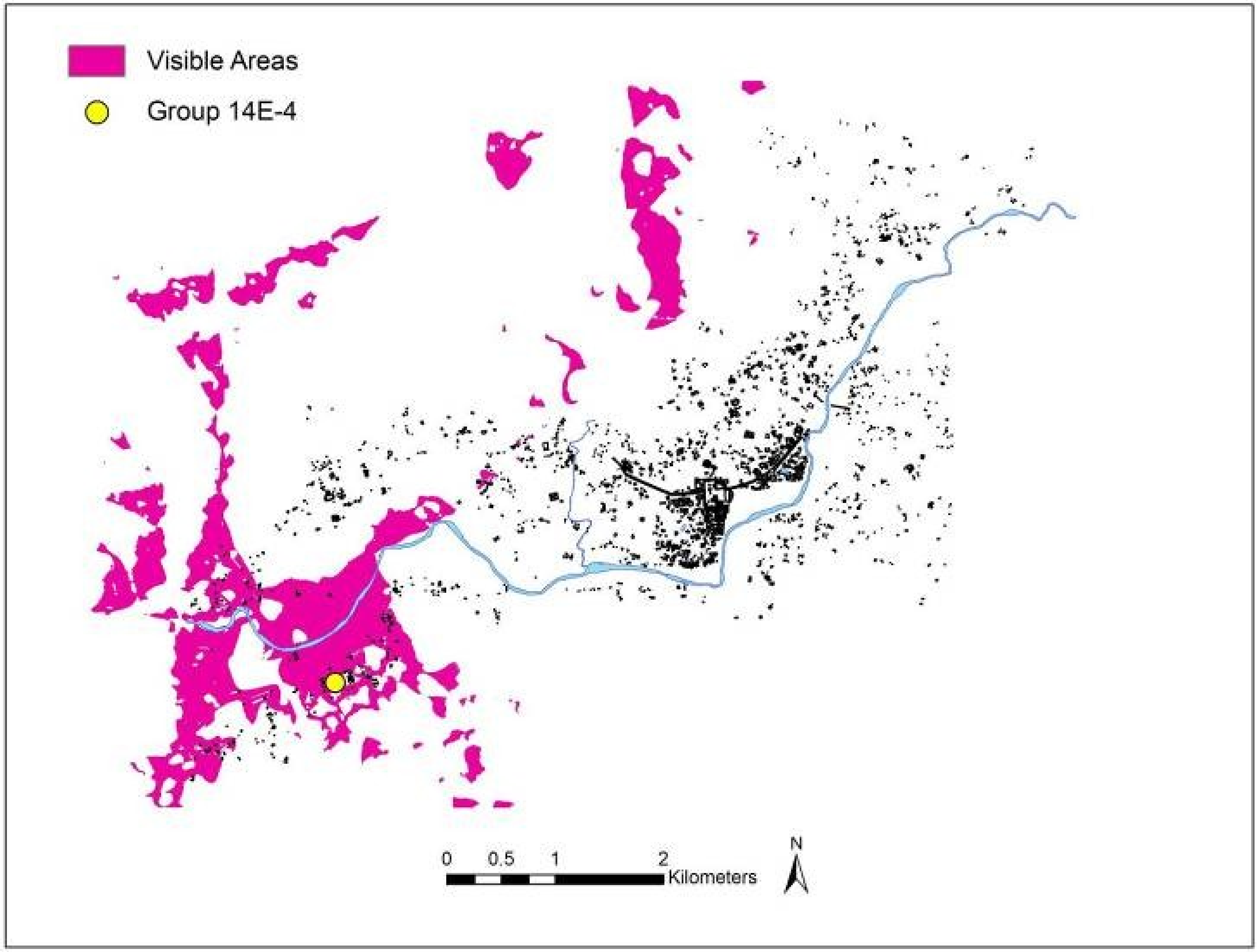
Map H.57: Viewshed of Group 12L-1 (Type 2), El Puente



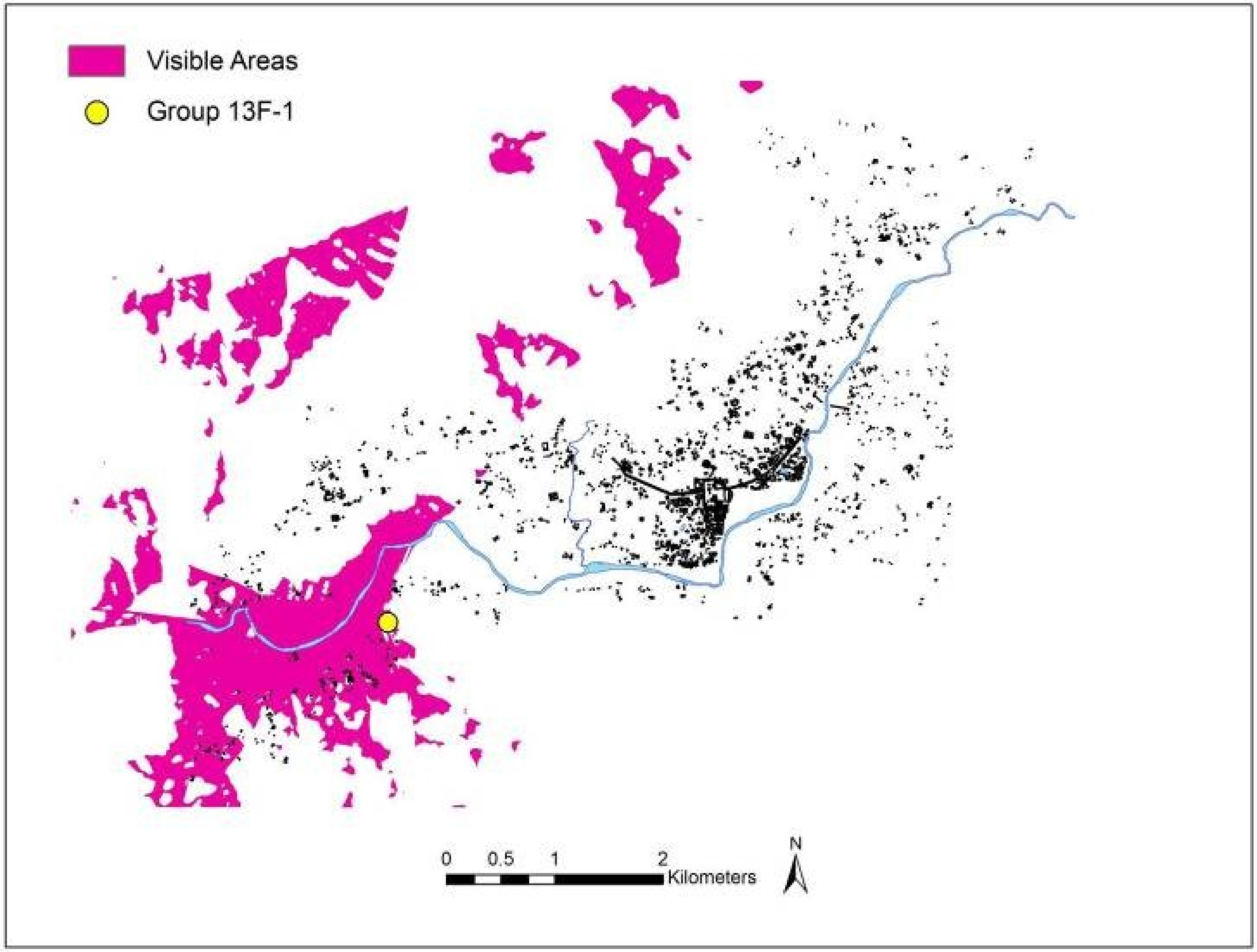
Map H.58: Viewshed of Group 12G-5 (Type 1), Algodonal



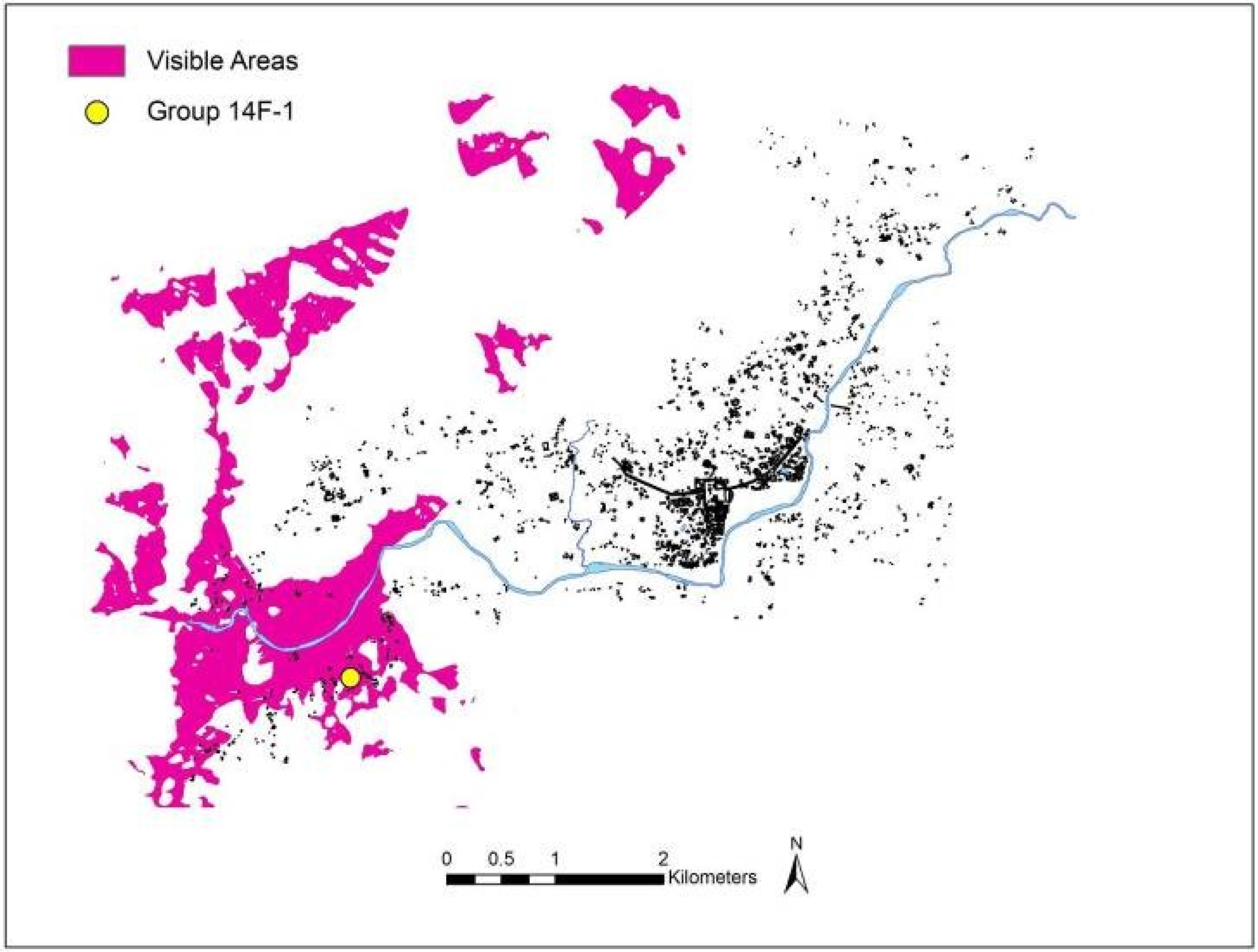
Map H.59: Viewshed of Group 12F-3 (Type 3), Algodonal



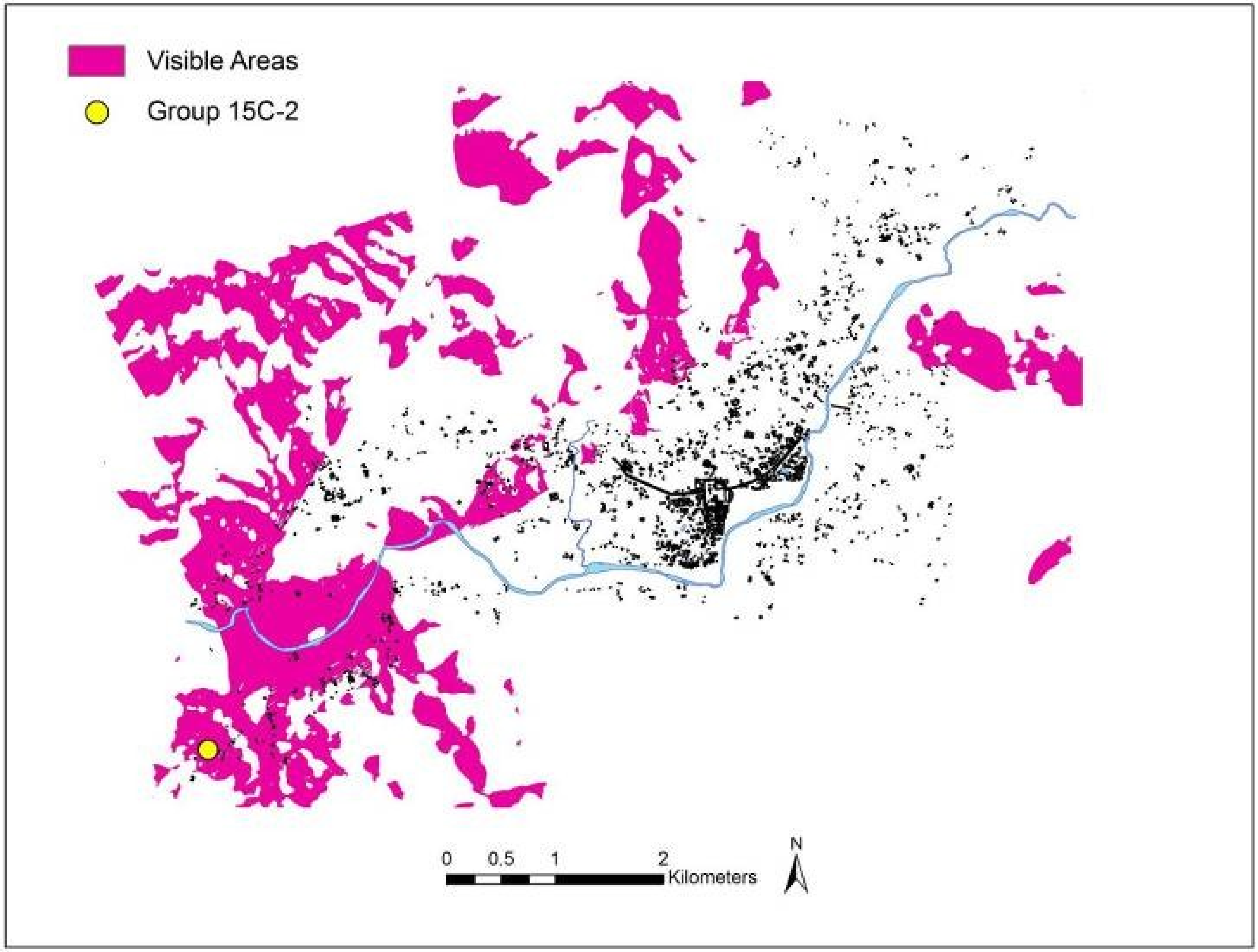
Map H.60: Viewshed of Group 14E-4 (Type 1), Estanzuela



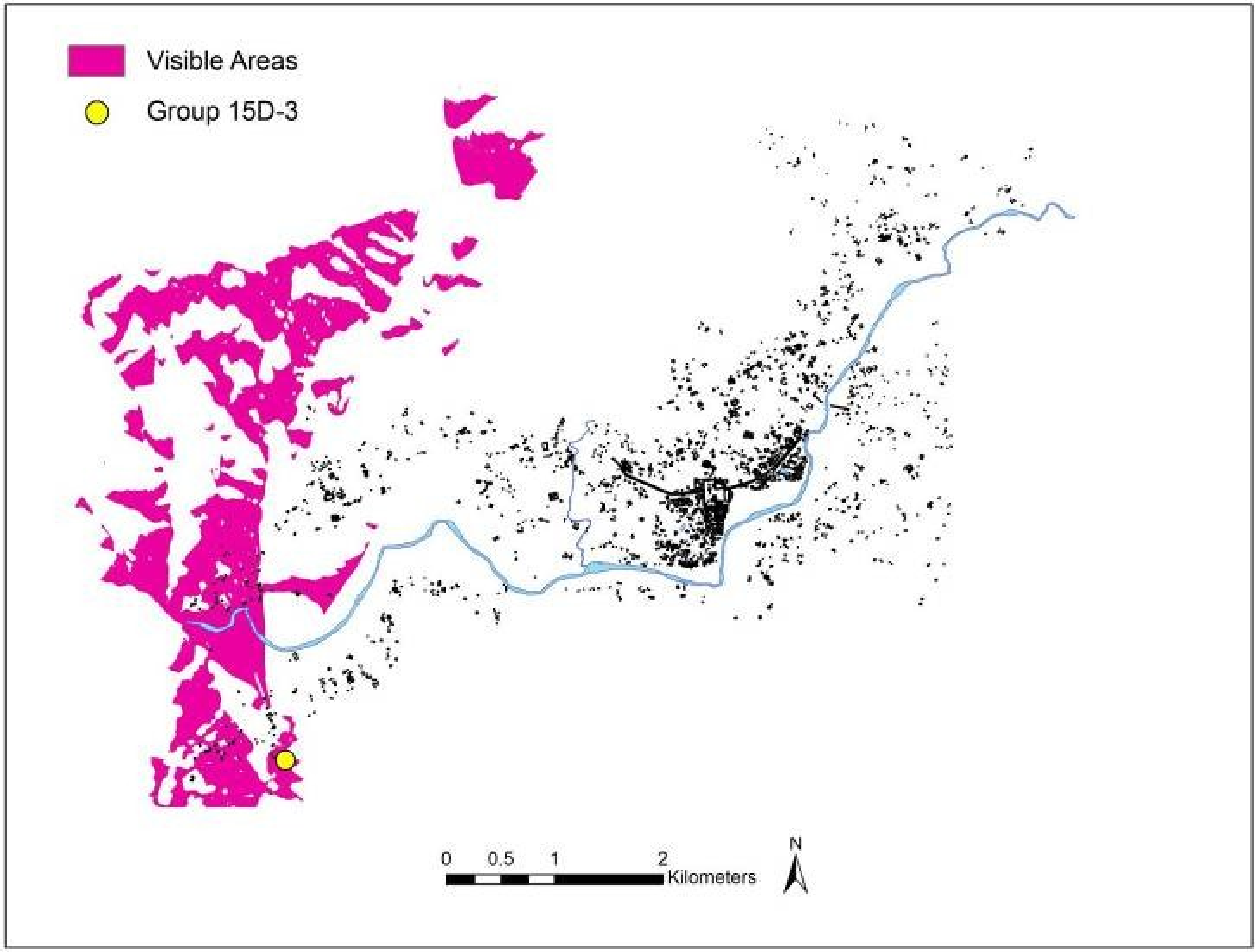
Map H.61: Viewshed of Group 13F-1 (Type 2), Estanzuela



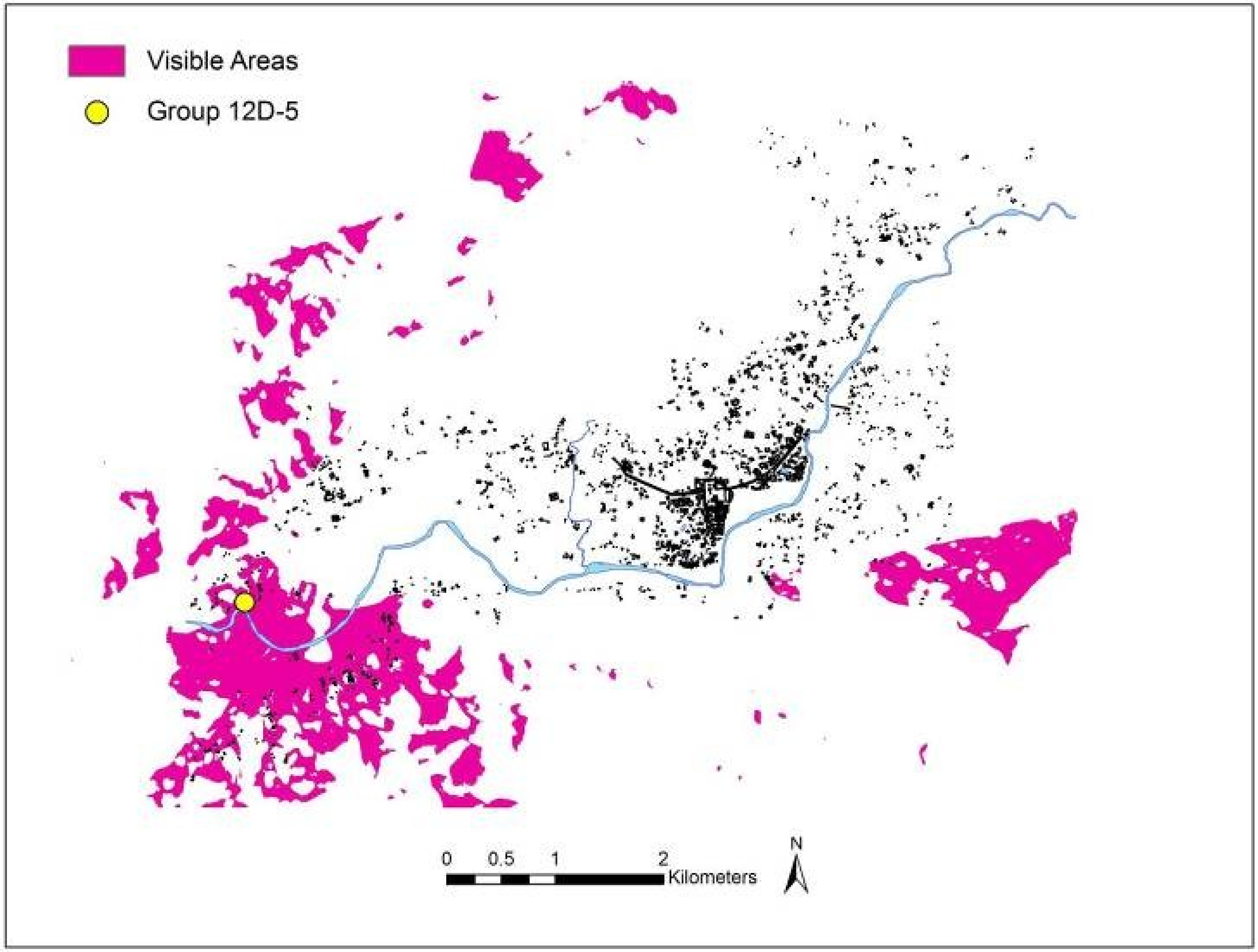
Map H.62: Viewshed of Group 14F-1 (Type 3), Estanzuela



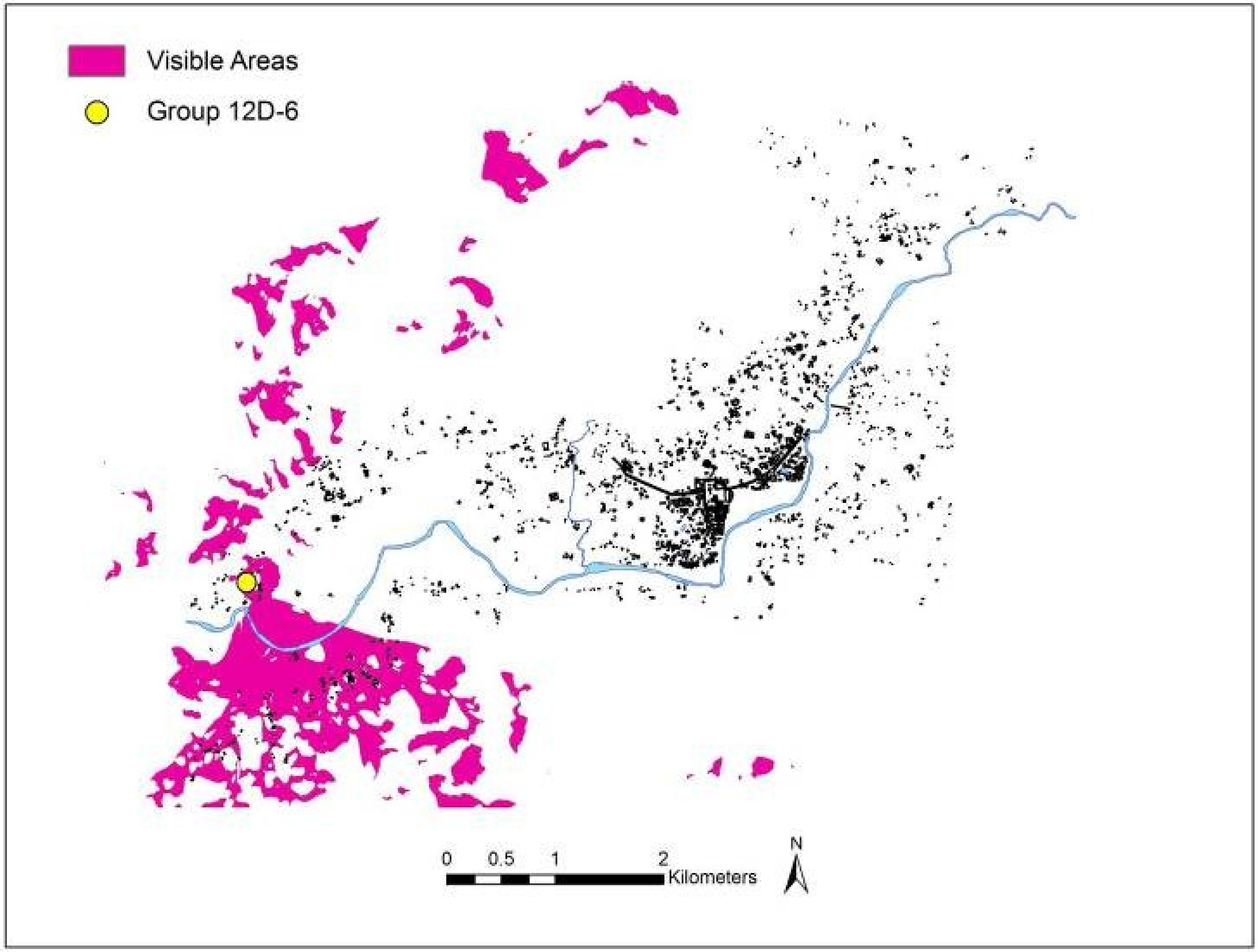
Map H.63: Viewshed of Group 15C-2 (Type 1), Tapescos



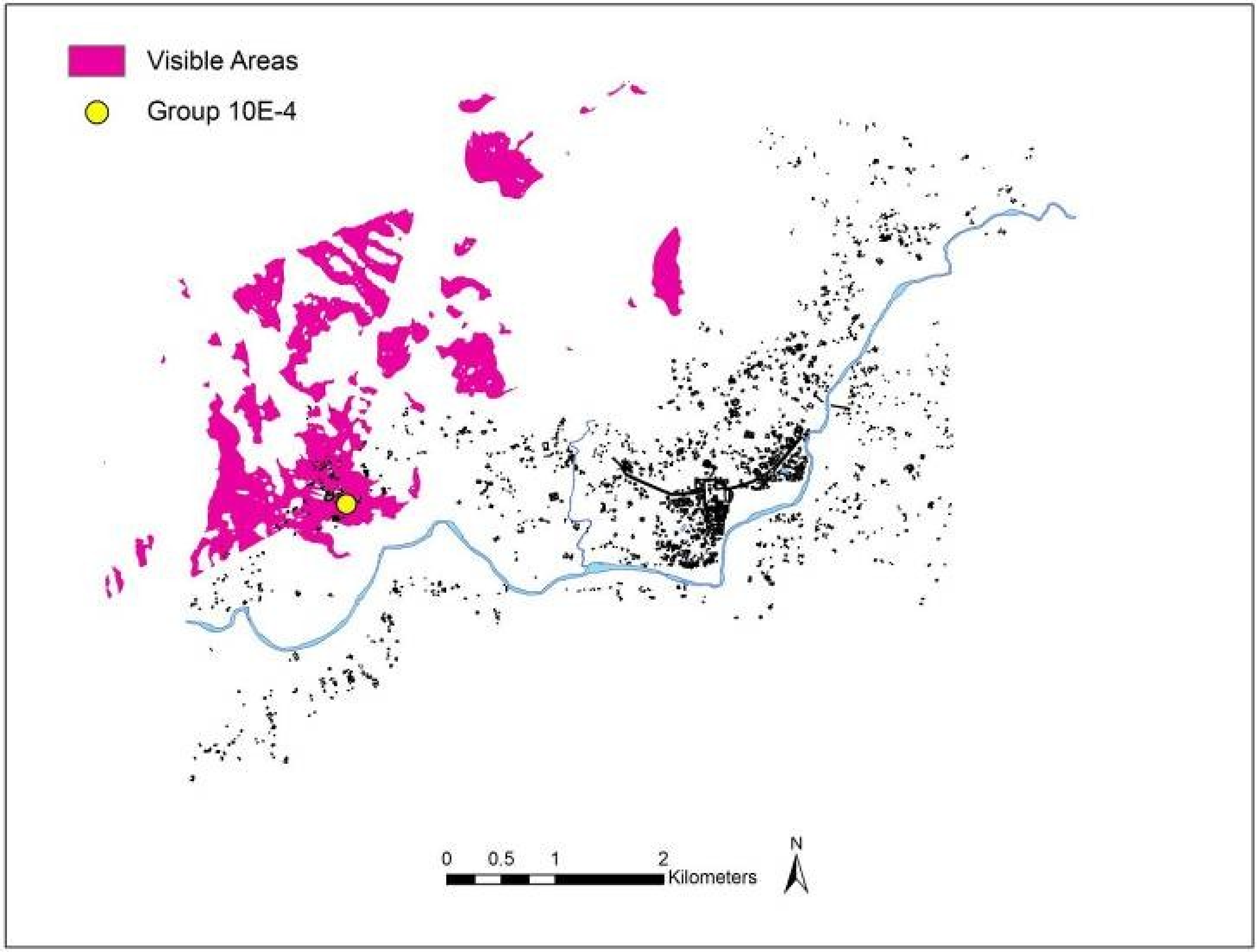
Map H.64: Viewshed of Group 15D-3 (Type 1), Tapescos



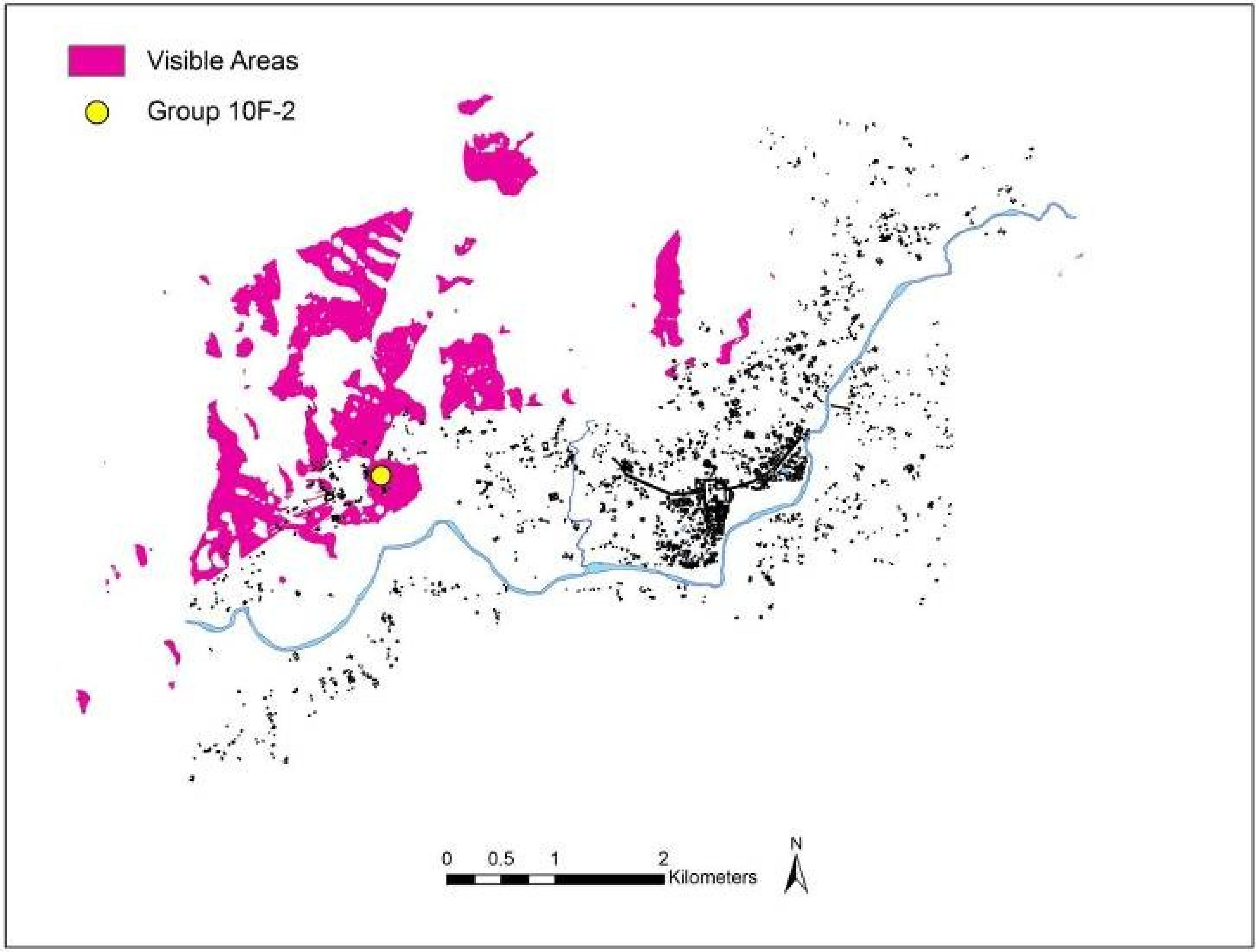
Map H.65: Viewshed of Group 12D-5 (Type 1), Rincon del Buey



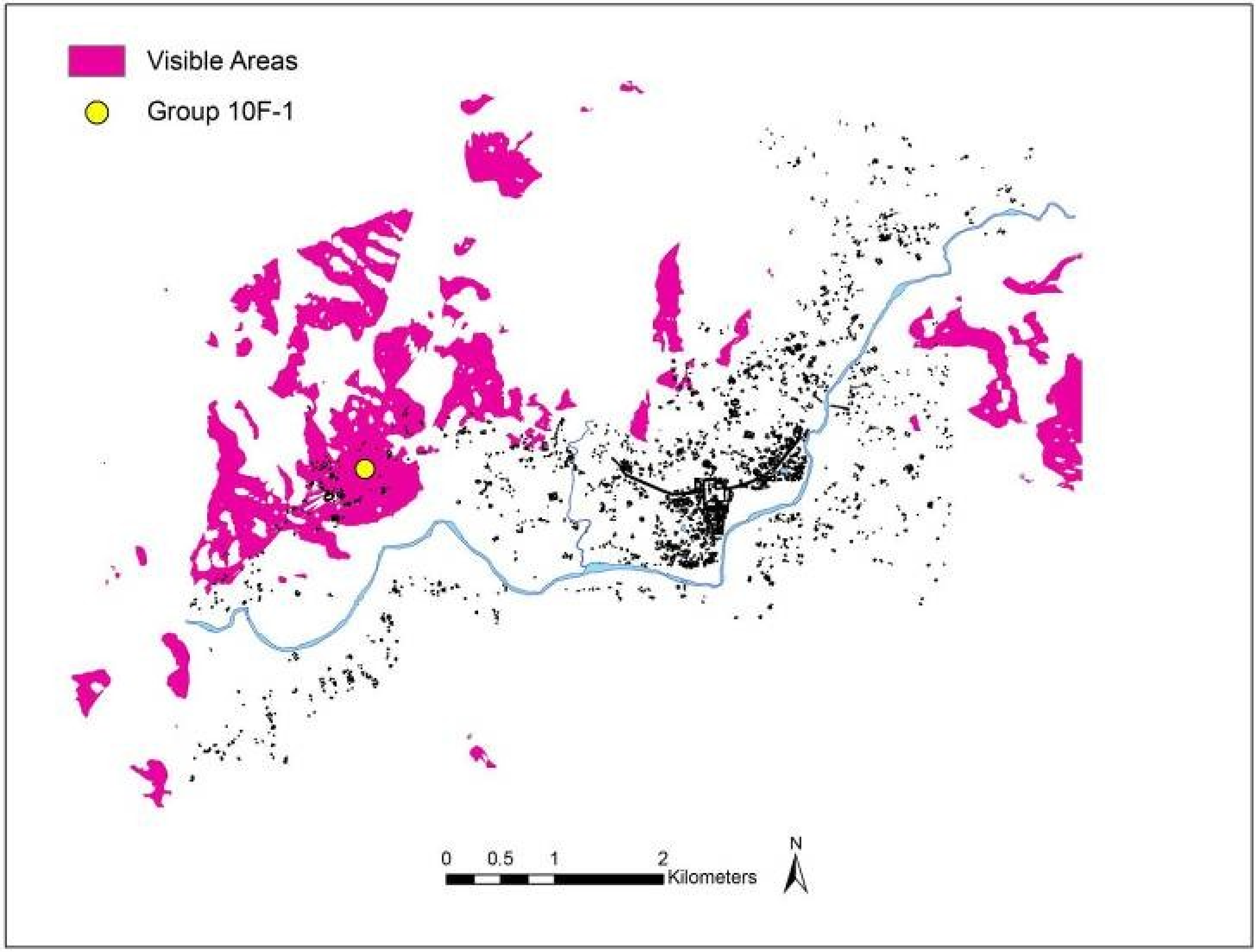
Map H.66: Viewshed of Group 12D-6 (Type 2), Rincon del Buey



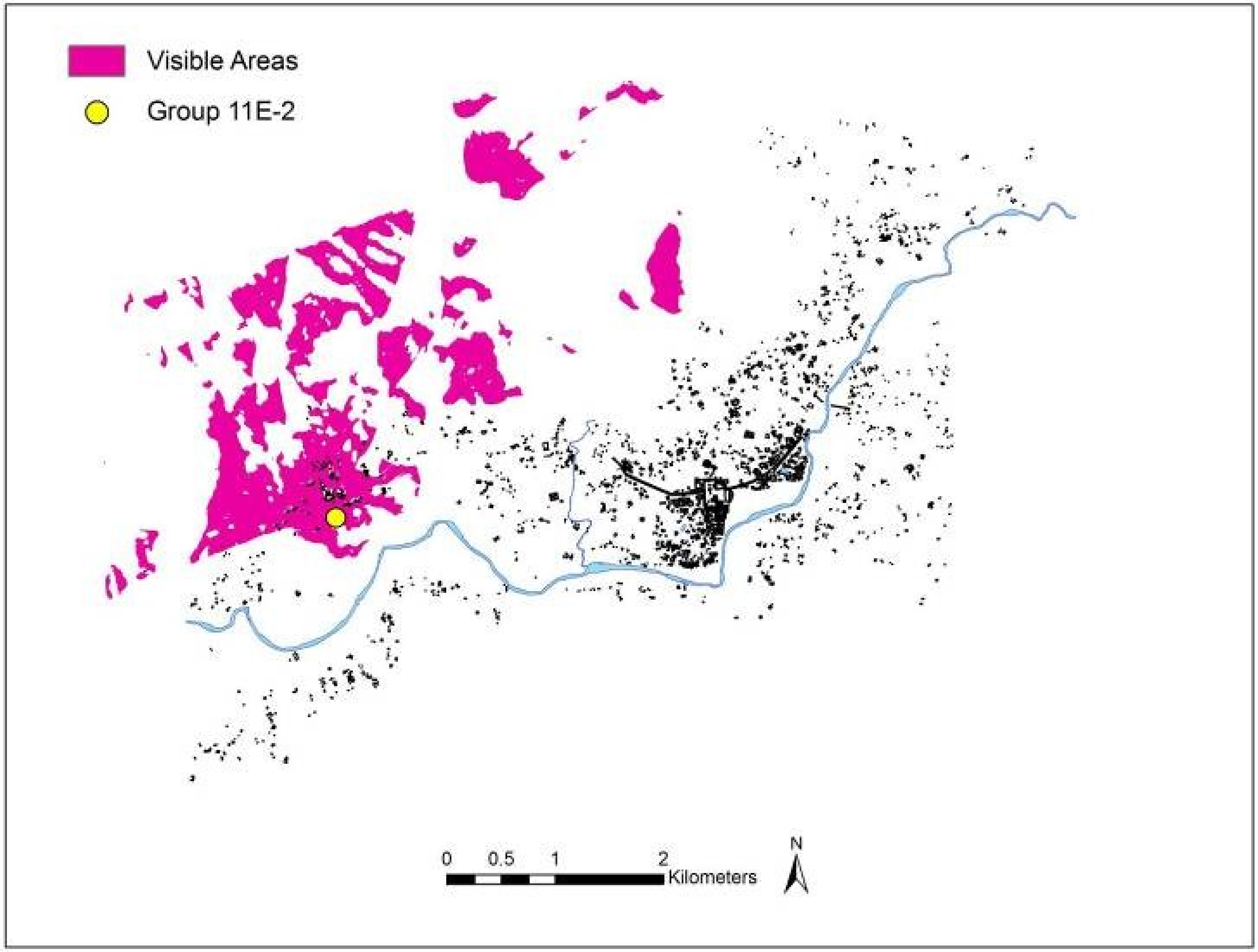
Map H.67: Viewshed of Group 10E-4 (Type 1), Ostuman



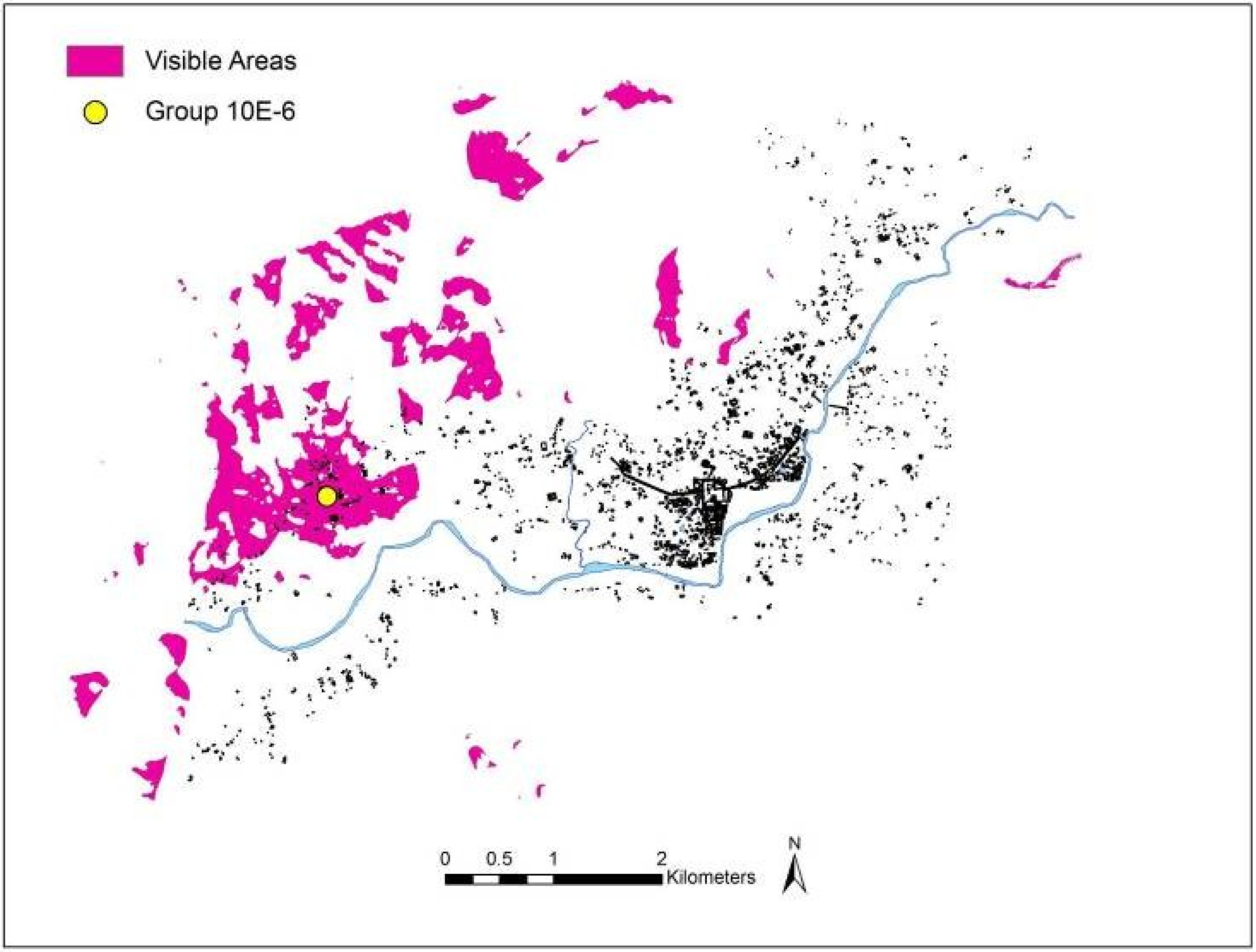
Map H.68: Viewshed of Group 10F-2 (Type 1), Ostuman



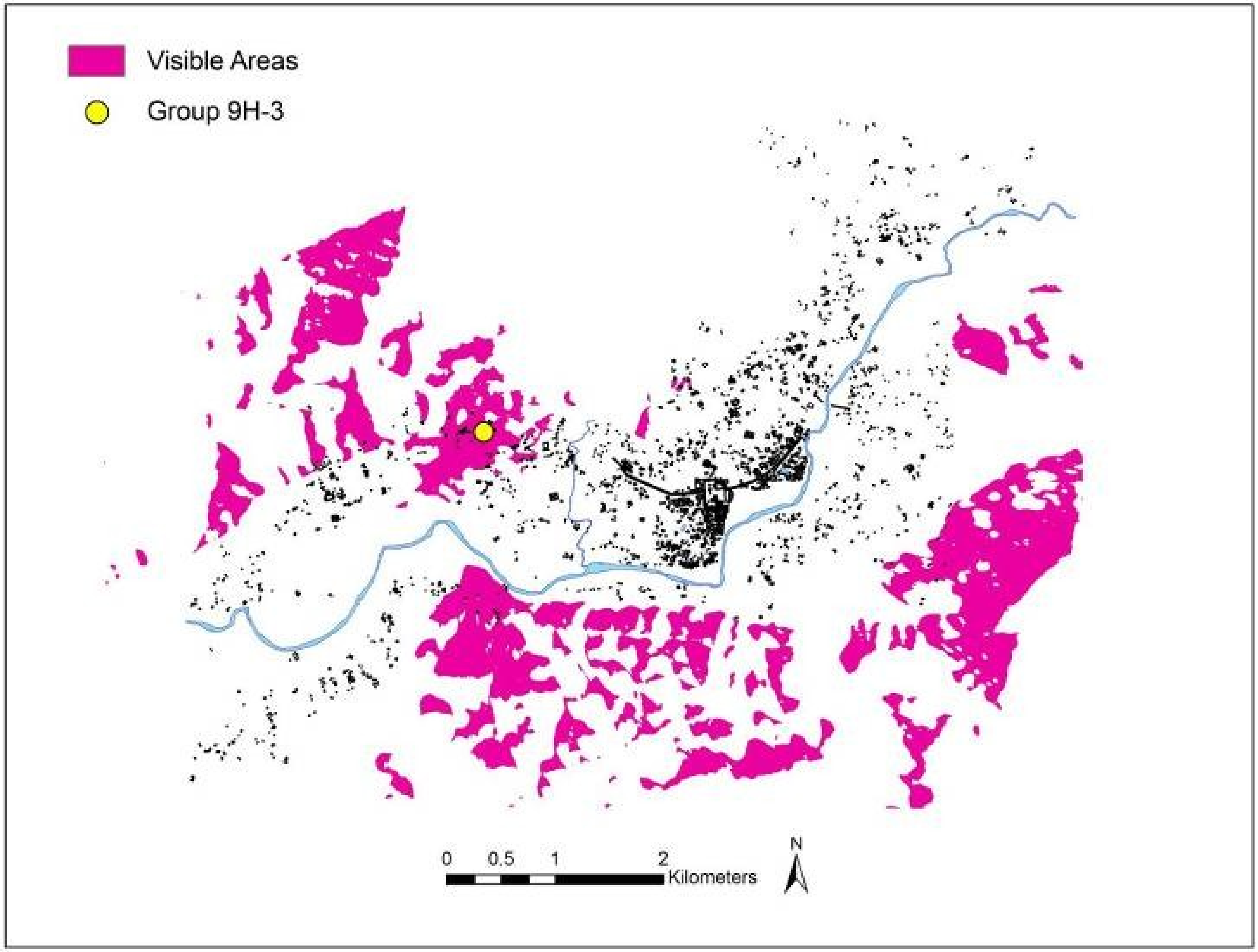
Map H.69: Viewshed of Group 10F-1 (Type 3), Ostuman



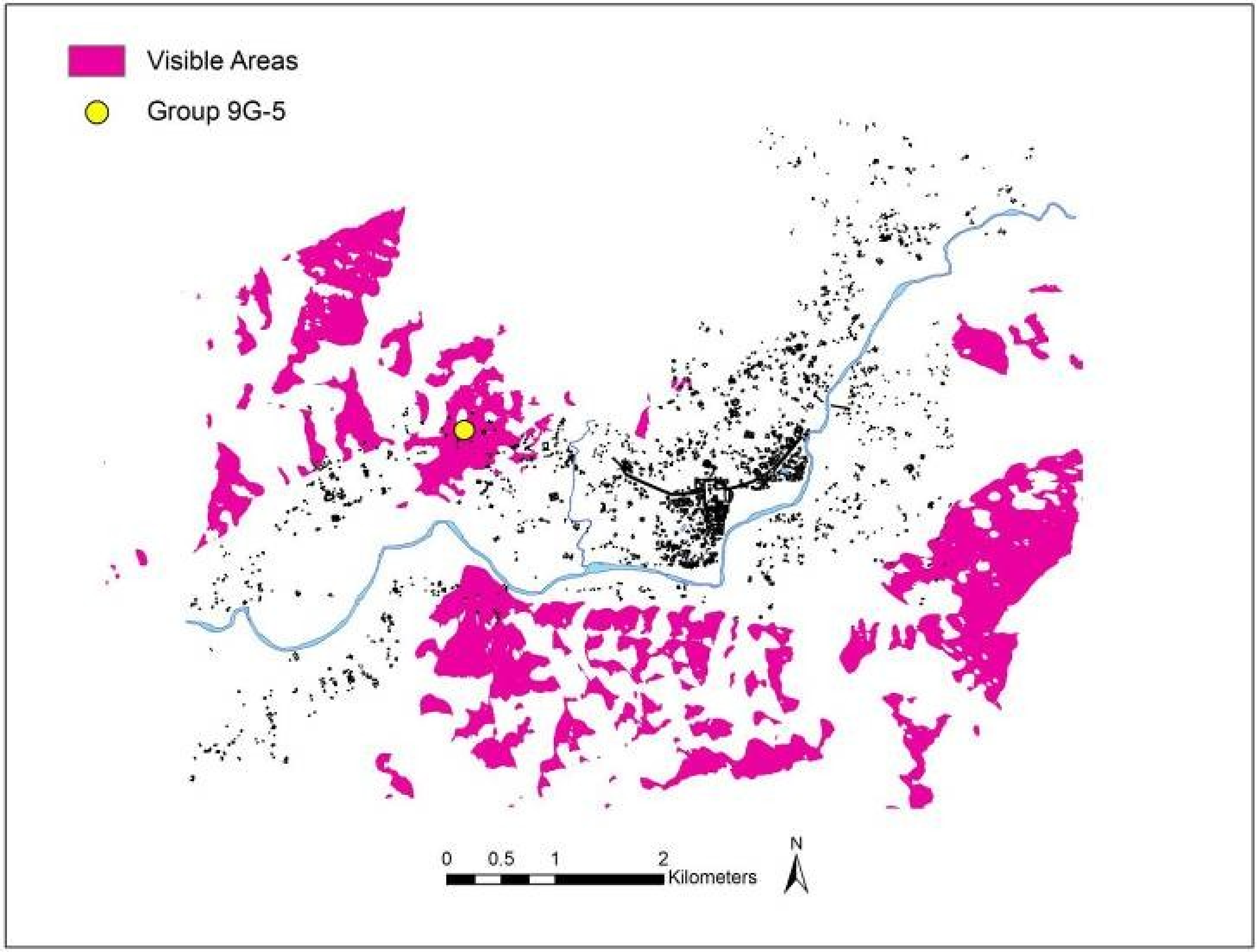
Map H.70: Viewshed of Group 11E-2 (Type 3), Ostuman



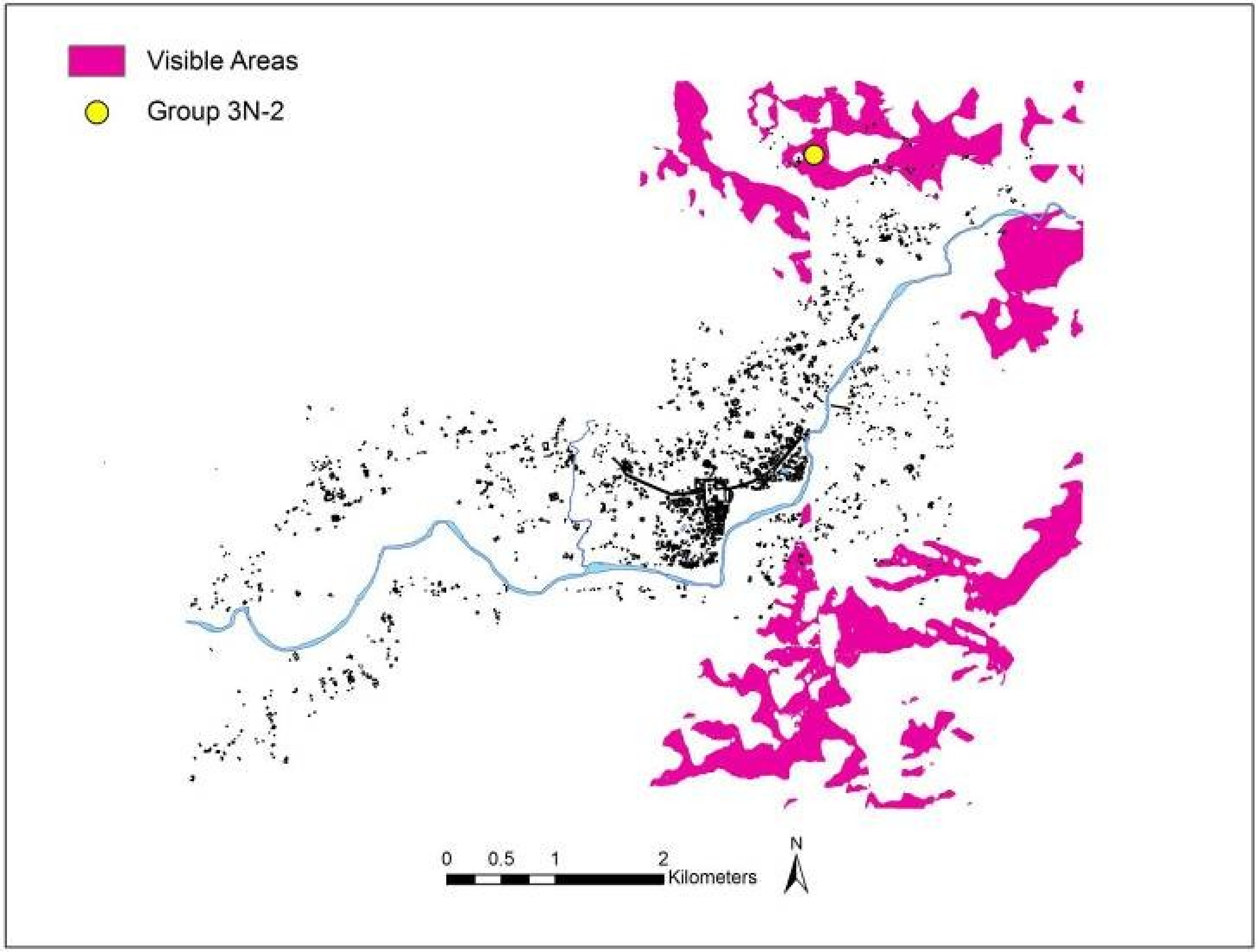
Map H.71: Viewshed of Group 10E-6 (Type 4), Ostuman



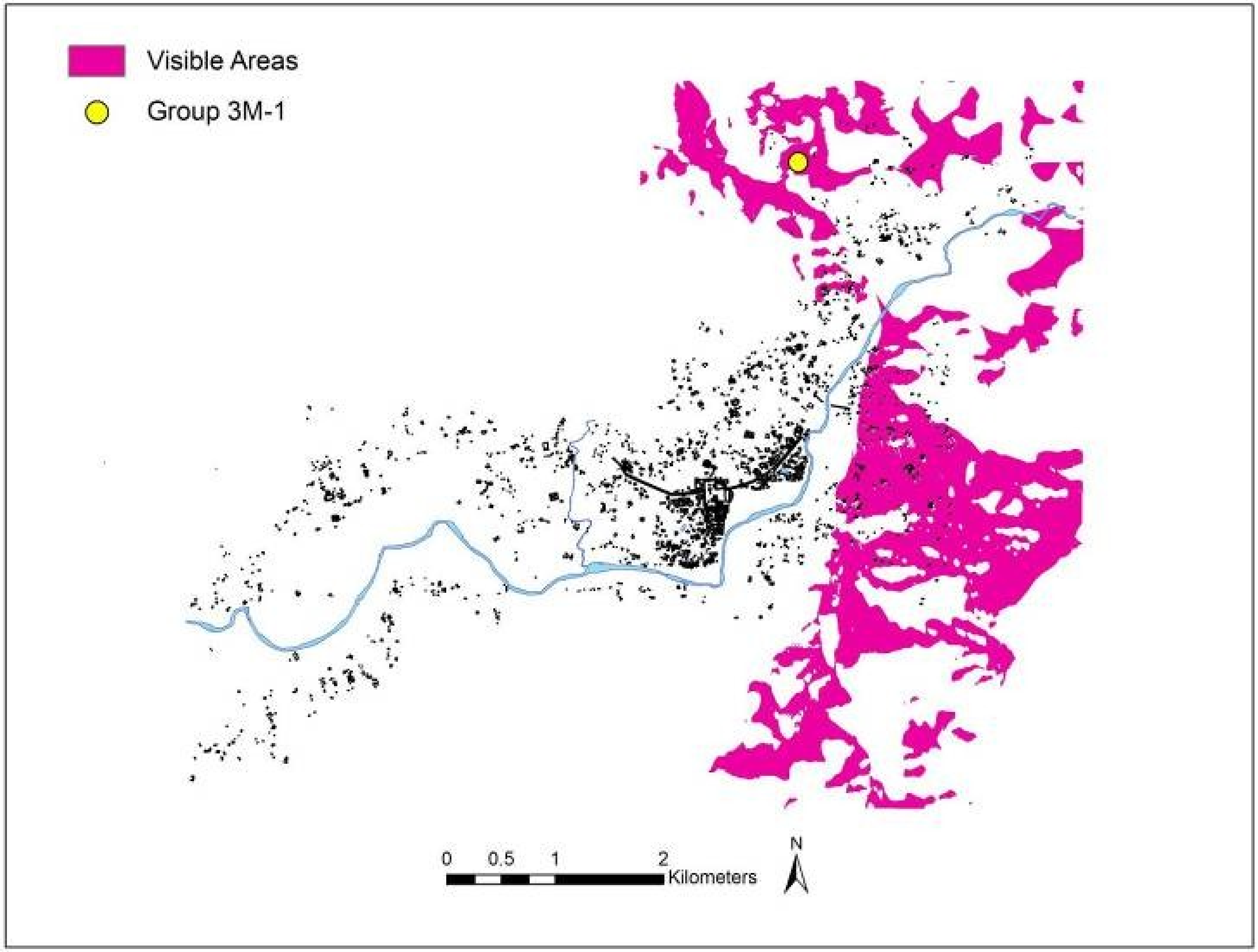
Map H.72: Viewshed of Group 9H-3 (Type 1), Yaragua



Map H.73: Viewshed of Group 9G-5 (Type 2), Yaragua



Map H.74: Viewshed of Group 3N-2 (Type 1), Quebrada Seca



Map H.75: Viewshed of Group 3M-1 (Type 2), Quebrada Seca

Appendix I: Visibility Summary Tables

Appendix I provides summary tables that list the visibility values for Copán's five site types. The tables include data from the site's five physiographic zones, its urban core and hinterlands, and its 20 residential *sian otots*.

<u>Physiographic Zones</u>

Zone 2

Type 1 Sites

Site Type	Visibility Value
1	0.3696
2	0.4825
3	**0.6000**
4	0.5333
5	0.9643
p-value = 0.024	

Table I.1: Kruskal-Wallis Test—visibility results for type 1 sites in Zone 2

Type 2 Sites

Site Type	Visibility Value
1	0.3877
2	0.5306
3	0.5200
4	**0.5333**
5	1.0000
p-value = 0.135	

Table I.2: Kruskal-Wallis Test—visibility results for type 2 sites in Zone 2

Type 3 Sites

Site Type	Visibility Value
1	0.4659
2	0.5789
3	**0.7000**
4	0.6666
5	0.7600
p-value = 0.169	

Table I.3: Kruskal-Wallis Test-visibility results for type 3 sites in Zone 2

Type 4 Sites

Site Type	Visibility Value
1	0.4535
2	0.5877
3	**0.8000**
4	0.5000
5	0.8666
p-value = 0.134	

Table I.4: Kruskal-Wallis Test—visibility results for type 4 sites in Zone 2

Zone 3

Type 1 Sites

Site Type	Visibility Value
1	0.2189
2	0.2593
3	**0.3000**
4	0.2916
5	0.5228
p-value = 0.537	

Table I.5: Kruskal-Wallis Test-visibility results for type 1 sites in Zone 3

Type 2 Sites

Site Type	Visibility Value
1	0.3992
2	0.3644
3	0.4400
4	**0.6166**
5	0.8021
p-value = 0.379	

Table I.6: Kruskal-Wallis Test—visibility results for type 2 sites in Zone 3

Type 3 Sites

Site Type	Visibility Value
1	0.3719
2	0.4945
3	0.5400
4	**0.7333**
5	0.8800
p-value = 0.012	

Table I.7: Kruskal-Wallis Test—visibility results for type 3 sites in Zone 3

Type 4 Sites

Site Type	Visibility Value
1	0.4058
2	0.5175
3	0.5600
4	**0.7333**
5	0.8666
p-value = 0.261	

Table I.8: Kruskal-Wallis Test—visibility results for type 4 sites in Zone 3

Zone 4

Type 1 Sites

Site Type	Visibility Value
1	0.5261
2	0.6535
3	**0.7000**
4	0.6666
5	0.9146
p-value = 0.079	

Table I.9: Kruskal-Wallis Test—visibility results for type 1 sites in Zone 4

Type 2 Sites

Site Type	Visibility Value
1	0.4818
2	0.6360
3	**0.7400**
4	0.6666
5	0.9000
p-value = 0.102	

Table I.10: Kruskal-Wallis Test—visibility results for type 2 sites in Zone 4

**There are no type3 or 4 sites located in zone 4.*

Zone 5

Type 1 Sites

Site Type	Visibility Value
1	**0.0884**
2	0.0701
3	0.0800
4	0.0000
5	0.0000
p-value = 0.074	

Table I.11: Kruskal-Wallis Test—visibility results for type 1 sites in Zone 5

Type 2 Sites

Site Type	Visibility Value
1	**0.0759**
2	0.0175
3	0.0600
4	0.0000
5	0.0000
p-value = 0.092	

Table I.12: Kruskal-Wallis Test—visibility results for type 2 sites in Zone 5

Type 3 Sites

Site Type	Visibility Value
1	0.0792
2	0.0482
3	**0.0800**
4	0.0330
5	0.2200
p-value = 0.436	

Table I.13: Kruskal-Wallis Test—visibility results for type 3 sites in Zone 5

Type 4 Sites

Site Type	Visibility Value
1	0.0612
2	0.0175
3	**0.0800**
4	0.0666
5	0.8666
p-value = N/A	

Table I.14: Kruskal-Wallis Test—visibility results for type 4 sites in Zone 5

Urban Core

Type 1 Sites

Site Type	Visibility Value
1	0.3594
2	0.4342
3	**0.5800**
4	0.4333
5	0.7182
p-value = 0.004	

Table I.15: Kruskal-Wallis Test—visibility results for type 1 sites in urban core

Type 2 Sites

Site Type	Visibility Value
1	0.3945
2	0.5175
3	**0.6400**
4	0.6000
5	1.0000
p-value = 0.007	

Table I.16: Kruskal-Wallis Test—visibility results for type 2 sites in urban core

Type 3 Sites

Site Type	Visibility Value
1	0.4353
2	0.5350
3	0.7200
4	**0.7333**
5	0.8800
p-value = 0.001	

Table I.17: Kruskal-Wallis Test—visibility results for type 3 sites in urban core

Type 4 Sites

Site Type	Visibility Value
1	0.4058
2	0.5614
3	0.6400
4	**0.7333**
5	0.8666
p-value = 0.013	

Table I.18: Kruskal-Wallis Test—visibility results for type 4 sites in urban

Hinterlands

Type 1 Sites

Site Type	Visibility Value
1	**0.1474**
2	0.0949
3	0.0800
4	0.0666
5	0.2580
p-value = 0.870	

Table I.19: Kruskal-Wallis Test—visibility results for type 1 sites in hinterlands

Type 2 Sites

Site Type	Visibility Value
1	**0.3514**
2	0.3070
3	0.1600
4	0.3333
5	0.2857
p-value = 0.980	

Table I.20: Kruskal-Wallis Test—visibility results for type 2 sites in hinterlands

Type 3 Sites

Site Type	Visibility Value
1	0.08390
2	0.05260
3	0.08000
4	**0.16665**
5	0.44000
p-value = 0.785	

Table I.21: Kruskal-Wallis Test—visibility results for type 3 sites in hinterlands

Type 4 Sites

Site Type	Visibility Value
1	0.0756
2	0.0395
3	**0.0800**
4	0.0333
5	0.7000
p-value = 0.166	

Table I.22: Kruskal-Wallis Test—visibility results for type 4 sites in hinterlands

Sian Otots

Salamar

Site Type	Visibility Value
1	0.389
2	0.540
3	0.560
4	**0.734**
5	0.727

Table I.23: Kruskal-Wallis Test—visibility results for sites in Salamar

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	[1]Y	N	[2]Y
Type 2			N	N	N
Type 3				N	N
Type 4					N
Significance level: [1] 0.0265 [2]0.0304					

Table I.24: Mann-Whitney Test—visibility results for sites in Salamar

Comedero

Site Type	Visibility Value
1	0.389
2	0.470
3	0.420
4	**0.617**
5	0.905

Table I.25: Kruskal-Wallis Test—visibility results for sites in Comedero

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	N	[1]Y
Type 2			N	N	[1]Y
Type 3				N	[1]Y
Type 4					N
Significance level: [1] 0.0265					

Table I.26: Mann-Whitney Test—visibility for sites in Comedero

El Bosque

Site Type	Visibility Value
1	0.375
2	0.513
3	0.520
4	**0.567**
5	0.977

Table I.27: Kruskal-Wallis Test—visibility results for sites in El Bosque

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		[1]**Y**	[2]**Y**	[3]**Y**	[4]**Y**
Type 2			**N**	**N**	[5]**Y**
Type 3				**N**	[4]**Y**
Type 4					[5]**Y**
Significance level: [1]0.0200 [2]0.0198 [3]0.0192 [4]0.0042 [5]0.0043 [5]0.0040					

Table I.28: Mann-Whitney Test—visibility results for sites in El Bosque

San Lucas

Site Type	Visibility Value
1	0.662
2	0.781
3	0.820
4	**0.867**
5	1.000

Table I.29: Kruskal-Wallis Test—visibility results for sites in San Lucas

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		**N**	**N**	**N**	**N**
Type 2			**N**	**N**	**N**
Type 3				**N**	**N**
Type 4					**N**

TableI.30: Mann-Whitney Test—visibility results for sites in San Lucas

Algodonal

Site Type	Visibility Value
1	0.361
2	0.417
3	0.360
4	**0.500**
5	0.375

Table I.31: Kruskal-Wallis Test—visibility results for sites in Algodonal

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		**N**	**N**	[1]**Y**	**N**
Type 2			[1]**Y**	[1]**Y**	**N**
Type 3				[1]**Y**	**N**
Type 4					**N**
Significance level: [1]0.0304					

Table I.32: Mann-Whitney Test—visibility results for sites in Algodonal

Rastrojon

Site Type	Visibility Value
1	0.393
2	0.408
3	0.560
4	**0.567**
5	0.481

TableI.33: Kruskal-Wallis Test—visibility results for sites in Rastrojon

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		**N**	**N**	**N**	**N**
Type 2			**N**	**N**	**N**
Type 3				**N**	**N**
Type 4					**N**

Table I.34: Mann-Whitney Test—visibility results for sites in Rastrojon

Titoror

Site Type	Visibility Value
1	0.138
2	0.167
3	**0.200**
4	**0.200**
5	0.571

Table I.35: Kruskal-Wallis Test—visibility results for sites in Titoror

Las Sepulturas

Site Type	Visibility Value
1	0.415
2	0.526
3	**0.700**
4	0.567
5	0.981

Table I.36: Kruskal-Wallis Test—visibility results for sites in Las Sepulturas

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		[1]Y	[2]Y	[3]Y	[4]Y
Type 2			[1]Y	N	[4]Y
Type 3				[3]Y	[4]Y
Type 4					[5]Y
Significance level: [1]0.0304 [2]0.0365 [3]0.0284 [4]0.0265 [5]0.0247					

Table I.37: Mann-Whitney Test—visibility results for sites in Las Sepulturas

San Rafael

Site Type	Visibility Value
1	0.649
2	0.737
3	**0.880**
4	0.800
5	0.841

Table I.38: Kruskal-Wallis Test—visibility results for sites in San Rafael

Ostuman

Site Type	Visibility Value
1	0.061
2	0.018
3	**0.080**
4	0.067
5	0.000

Table I.39: Kruskal-Wallis Test—visibility results for sites in Ostuman

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		[1]Y	N	N	[1]Y
Type 2			[1]Y	[1]Y	[1]Y
Type 3				[1]Y	[1]Y
Type 4					[1]Y
Significance level: [1]0.0122					

Table I.40: Mann-Whitney Test—visibility results for sites in Ostuman

Chorro

Site Type	Visibility Value
1	0.435
2	0.386
3	0.600
4	**0.733**
5	0.667

Table I.41: Kruskal-Wallis Test—visibility results for sites in Chorro

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	N	N
Type 2			N	N	N
Type 3				N	N
Type 4					N

Table I.42: Mann-Whitney Test—visibility results for sites in Chorro

Titichon

Site Type	Visibility Value
1	0.372
2	0.465
3	**0.640**
4	0.467
5	0.765

Table I.43: Kruskal-Wallis Test—visibility results for sites in Titichon

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	N	N
Type 2			N	N	N
Type 3				N	N
Type 4					N

Table I.44: Mann-Whitney Test—visibility results for sites in Titichon

Mesa de Petapilla

Site Type	Visibility Value
1	0.181
2	0.237
3	**0.400**
4	0.333
5	0.286

Table I.45: Kruskal-Wallis Test—visibility results for sites in Mesa de Petapilla

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	N	N
Type 2			N	N	N
Type 3				N	N
Type 4					N

Table I.46: Mann-Whitney Test—visibility results for sites in Mesa de Petapilla

El Puente

Site Type	Visibility Value
1	0.396
2	**0.579**
3	0.540
4	0.533
5	1.000

Table I.47: Kruskal-Wallis Test—visibility results for sites in El Puente

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	[1]Y	N
Type 2			N	N	N
Type 3				N	N
Type 4					N

Table I.48: Mann-Whitney Test—visibility results for sites in El Puente

Bolsa de Petapilla

Site Type	Visibility Value
1	0.059
2	**0.061**
3	0.000
4	0.000
5	0.000

Table I.49: Kruskal-Wallis Test—visibility results for sites in Bolsa de Petapilla

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	N	N
Type 2			N	N	N
Type 3				N	N
Type 4					N

Table I.50: Mann-Whitney Test—visibility results for sites in Bolsa de Petapilla

El Pueblo

Site Type	Visibility Value
1	**0.147**
2	0.095
3	0.080
4	0.063
5	0.385

Table I.51: Kruskal-Wallis Test—visibility results for sites in El Pueblo

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	N	N
Type 2			N	N	N
Type 3				N	N
Type 4					N

Table I.52: Mann-Whitney Test—visibility results for sites in El Pueblo

Yaragua

Site Type	Visibility Value
1	**0.066**
2	0.013
3	0.000
4	0.000
5	0.000

Table I.53: Kruskal-Wallis Test—visibility results for sites in Yaragua

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	N	N
Type 2			N	N	N
Type 3				N	N
Type 4					N

Table I.54: Mann-Whitney Test—visibility results for sites in Yaragua

Estanzuela

Site Type	Visibility Value
1	**0.086**
2	0.053
3	0.080
4	0.000
5	0.000

Table I.55: Kruskal-Wallis Test—visibility results for sites in Estanzuela

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	N	N
Type 2			N	N	N
Type 3				N	N
Type 4					N

TableI.56: Mann-Whitney Test—visibility results for sites in Estanzuela

Rincon del Buey

Site Type	Visibility Value
1	**0.107**
2	0.044
3	0.040
4	0.000
5	0.214

Table I.57: Kruskal-Wallis Test—visibility results for sites in Rincon del Buey

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		N	N	N	N
Type 2			N	N	N
Type 3				N	N
Type 4					N

Table I.58: Mann-Whitney Test—visibility results for sites in Rincon del Buey

Tapescos

Site Type	Visibility Value
1	**0.102**
2	0.053
3	0.040
4	0.000
5	0.000

Table I.59: Kruskal-Wallis Test—visibility results for sites in Tapescos

	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1		**N**	**N**	**N**	**N**
Type 2			**N**	**N**	**N**
Type 3				**N**	**N**
Type 4					**N**

Table I.60: Mann-Whitney Test—visibility results for sites in Tapescos

References

Abercrombie, Nicholas, Stephen Hill, and Bryan S. Turner
1980 *The Dominant Ideology Thesis*. G. Allen & Unwin, London and Boston.

Abrams, Elliot
1987 Economic Specialization and Construction Personnel in Classic Period Copan, Honduras. *American Antiquity* 52(3):485–499.
1994 *How the Maya Built Their World: Energetics and Ancient Architecture*. University of Texas Press, Austin.
1995 A Model of Fluctuating Labor Value and the Establishment of State Power: An Application to the Prehispanic Maya. *Latin American Antiquity* 60(3): 196–213.

Abrams, Elliot, and David J. Rue
1988 The Causes and Consequences of Deforestation Among the Prehistoric Maya. *Human Ecology* 16(4):377–395.

Agurcia Fasquelle, Ricardo
1996 Tierra, tiestos, piedras, estratigrafía y escultura: investigaciones en la estructura 10L-16 de Copán. In *Visión del pasado maya: Proyecto Arqueológico Acrópolis de Copán*, edited by W. Fash and R. Agurcia Fasquelle, pp.185–201. Credomatic, San Pedro Sula, Honduras.
2004 Rosalilla, Temple of the Sun-King. In *Understanding Early Classic Copan*, edited by E. Bell, M. Canuto, and R. Sharer, pp. 101–111. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Agurcia Fasquelle, Ricardo, and Barbara Fash
2005 The Evolution of Structure 10L-16, Heart of the Copán Acropolis. In *Copán: The History of an Ancient Kingdom*, edited by E. Wyllys Andrews and William L. Fash, pp. 201-237. School of American Research Advanced Seminar Series: Santa Fe.

Ahlfeldt, Jennifer
2004 On Reconstructing and Performing Ancient Maya Architecture: Structure 22, Copán Honduras (AD 715). Unpublished Ph.D. Dissertation, Columbia University, New York City.

Andrews, George F.
1975 *Maya Cities: Placemaking and Urbanization*. University of Oklahoma Press, Norman.

Andrews, Wyllys E., and Cassandra Bill
2005 A Late Classic Royal Residence at Copán. In *Copán: The History of an Ancient Kingdom*, edited by E. Wyllys Andrews and William L. Fash, pp. 239–314. School of American Research Advanced Seminar Series, Santa Fe.

Andrews, Wyllys E., and Barbara Fash
1992 Continuity and Change in a Royal Maya Residential Compound at Copán. *Ancient Mesoamerica* 3:63–88.

Andrews, Wyllys E., and William L. Fash
2005 Issues in Copán Archaeology. In *Copán: The History of an Ancient Kingdom*, edited by E. Wyllys Andrews and William L. Fash, pp. 395–425. School of American Research Advanced Seminar Series: Santa Fe, NM.

Ashmore, Wendy
1981 Some Issues of Method and Theory in Lowland Maya Settlement Archaeology. In *Lowland Maya Settlement Patterns*, edited by W. Ashmore, pp. 37–69. University of New Mexico Press, Albuquerque.
1986 Péten Cosmology in the Maya Southeast: An Analysis of Architecture and Settlement Patterns at Classic Quiriguá. In *The Southeast Maya Periphery*, edited by P. Urban and E. Schortman, pp. 35–49. University of Texas Press, Austin.
1989 Construction and Cosmology: Politics and Ideology in Lowland Maya Settlement Patterns. In W*ord and Image in Maya Culture: Explorations in Language, Writing, and Representation*, edited by W. Hanks and D. Rice, pp. 272–286. University of Utah Press, Salt Lake City.
1991 Site-Planning Principles and Concepts of Directionality among the Ancient Maya. *Latin American Antiquity* 2(3):199–226.
1992 Deciphering Maya Architectural Plans. In *New Theories on the Ancient Maya*, edited by E. Danien and R. Sharer, pp. 173–184. University Museum, University of Pennsylvania, Philadelphia.
2004 Classic Maya Landscapes and Settlement. In *Mesoamerican Archaeology: Theory and Practice*, edited by J. Hendon and R. Joyce, pp. 169-191. Blackwell Publishing, Oxford.

Ashmore, Wendy, and Jeremy Sabloff
2002 Spatial Orders in Maya Civic Plans. *Latin American Antiquity* 13(2):201–215.
2003 Interpreting Ancient Maya Civic Plans: Reply to Smith. *Latin American Antiquity* 14(2):229–236.

Aveni, Anthony
1993 *Ancient Astronomers*. Smithsonian, Washington, D.C.
2001 *Stairways to the Stars: Skywatching in Three Great Ancient Cultures*. J. Wiley, New York.

Aveni, Anthony, and Horst Hartung
1986 Archaeoastronomy and Dynastic History at Tikal. In *Maya City Planning and the Calendar*, edited by A. Aveni and H. Hartung, pp. 1–16. The American Philosophical Society, Philadelphia.

Barnhart, Edwin L.
2001 The Palenque Mapping Project: Settlement and Urbanism at an Ancient Maya City. Unpublished Ph.D. Dissertation, University of Texas, Austin.

Barthes, Roland
1967 *Elements of Semiology*. Hill and Wang, New York.
1986 Semiology and the Urban. In *The City and the Sign: An Introduction to Urban Semiotics*, edited by M. Gottdiener and A. Lagopoulos pp. 87−98. Columbia University Press, New York.

Basso, Keith
1996 *Wisdom Sits in Places: Landscape and Language among the Western Apache*. University of New Mexico Press, Albuquerque.

Batty, Michael
2004 A New Theory of Space Syntax, pp. 1−36. Center for Advanced Spatial Analysis, http://www.casa.ucl.ac.uk/working_papers/paper75.pdf.

Batty, Michael,and Paul A. Longley
2003 *Advanced Spatial Analysis: The CASA Book of GIS*. ESRI Press, Redlands.

Baudez, Claude-Francois
1983 *Introducción a la Arqueología de Copán, Honduras*. Proyecto Arqueológico Copán, Secretaria de Estado en el Despacho de Cultura y Turismo, Tegucigalpa, D.C.
1989 House of the Bacabs: An Iconographic Analysis. In *House of the Bacabs, Copan, Honduras*, edited by D. Webster, pp. 73−81. Studies in Pre-Columbian Art and Archaeology no. 29. Dumbarton Oaks, Washington D.C.
1991 The Cross Pattern at Copán: Forms, Rituals, and Meanings. In *Sixth Palenque Round Table*, 1986, pp. 81−88. University of Oklahoma Press, Norman and London.
1994 *Maya Sculpture of Copán: The Iconography*. University of Oklahoma Press, Norman and London.
2000 The Maya King's Body, Mirror of the Universe. *RES* 38, Autumn:134−143.

Becker, Marshall J.
1982 Ancient Maya Houses and Their Identifications: An Evaluation of Architectural Groups at Tikal and Inferences Regarding their Function. *Revista Española de Antropología Americana* 12:113−129.

Bell, Ellen E., Marcello A. Canuto, and Robert J. Sharer (editors)
2004 *Understanding Early Classic Copan*. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Bill, Cassandra
1997 Patterns of Variation and Change in Dynastic-Period Ceramics and Ceramic Production at Copán, Honduras. Unpublished Ph.D. Dissertation, Department of Anthropology, Tulane University, New Orleans.

Blanton, Richards E.
1989 Continuity and Change in Public Architecture: Periods I through V of the Valley of Oaxaca, Mexico. In *Monte Alban's Hinterland, Part II: Prehispanic Settlement Patterns in Tlacolula, Etla, and Ocotlan, the Valley Of Oaxaca, Mexico*. Edited by S. Kowalewski, G. Feinman, L. Finsten, R. Blanton, and L. M. Nicholas, pp. 409−447. Memoirs of the Museum of Anthropology No. 23, University of Michigan, Ann Arbor.

Bouissac, Paul
1998 *Encyclopedia of Semiotics*. Oxford University Press, New York.

Bourdieu, Pierre
1977 *Outline of a Theory of Practice*. Translated by Richard Nice. Cambridge University Press: Cambridge and New York.

Brady, James E., and Wendy Ashmore
1999 Mountains, Caves, Water: Ideational Landscapes of the Ancient Maya. In *Archaeologies of Landscape: Contemporary Perspectives*, edited by Wendy Ashmore and A. Bernard Knapp, pp. 124−145. Blackwell Publishers, Oxford.

Brewer, Douglas, and Emily Teeter
1999 *Egypt and the Egyptians*. Cambridge University Press, Cambridge.

Bricker, Victoria B.
1983 Directional Glyphs in Maya Inscriptions and Codices. *American Antiquity* 48: 347−353.

Broadbent, Geoffrey
1980 The Deep Structures of Architecture. In *Signs, Symbols, and Architecture*, edited by G. Broadbent, Richard Bunt, and Charles Jencks. John Wiley & Sons. New York.

Buchler, Justus
1978 *Philosophical Writings of Peirce*. Dover Publications, New York.

Buikstra, J., T. Douglas Price, Lori E. Wright, and James A. Burton
2004 Tombs from the Copan Acropolis: A Life History Approach. In *Understanding Early Classic Copan*, edited by E. Bell, M. Canuto, and R. Sharer, pp. 191−212. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Bullard, W.
1960 Maya Settlement Pattern in Northeastern Peten, Guatemala. *American Antiquity* 25:355–372.

Burks, Arthur
1949 Icon, Index, Symbol. *Philosophy and Phenomenological Research* 9.4: 673–689

Bustard, W. J.
1996 Space as place: small and great house spatial organization in Chaco Canyon, New Mexico A.D. 1000-1150. Unpublished Ph.D. Dissertation, University of New Mexico, Albuquerque.

Canuto, Marcello A.
2004 The Rural Settlement of Copan: Changes through the Early Classic. In *Understanding Early Classic Copan*, edited by E. Bell, M. Canuto, and R. Sharer, pp. 29–50. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.
2002 *A Tale of Two Cities: The Role of the Rural Community in the Socio-Political Integration of the Copan Drainage in the Late Preclassic and Classic Periods*. Ph.D. Thesis, Department of Anthropology, University of Pennsylvania.

Canuto, Marcello A., and Ellen E. Bell
2008 The Ties that Bind: Strategies in the El Paraíso Valley, Department of Copan, Honduras. *Mexicon*, Vol. XXX, pp. 10–20.

Carrelli, Christine W.
2004 Measures of Power: The Energetics of Royal Construction at Early Classic Copan. In *Understanding Early Classic Copan*, edited by E. Bell, M. Canuto, and R. Sharer, pp.113–127. University of Pennsylvania Museum of Archaeology and Anthropology Press, Philadelphia.

Casey, Edward
1987 *Remembering: A Phenomenological Study*. Indiana University Press: Bloomington.
1993 *Getting Back into Place: Toward a Renewed Understanding of the Place-World*. Indiana University Press, Bloomington.

Chase, Diane, and Arlen Chase (editors)
1992 *Mesoamerican Elites: An Archaeological Assessment*. University of Oklahoma Press, Norman and London.

Chase, D., Arlen Chase, and William Haviland
1990 The Classic Maya City: Reconsidering “the Mesoamerican Urban Tradition”. *American Anthropologist* 92:499–506.

Cheek, Charles D.
1983 Excavaciones en la Plaza Principal. In *Introducción a la Arqueología de Copán, Honduras*, edited by C.F. Baudez, pp. 191–289. Proyecto Arqueológico Copán, Secretaria de Estado en el Despacho de Cultura y Turismo, Tegucigalpa, D.C
2003 Maya Community Buildings: Two Late Classic popal nahs at Copan, Honduras. *Ancient Mesoamerica* (14):131–138.

Cheek, Charles D., and Veroncia Kennedy Embree
1983 Estructura 10L-2. In *Introducción a la Arqueología de Copán, Honduras*, edited by C.F. Baudez, pp. 93–141. Proyecto Arqueologico Copán, Secretaria de Estado en el Despacho de Cultura y Turismo, Tegucigalpa, D.C.

Childe, V. Gordon
1950 The Urban Revolution. *Town Planning Review* 21: 3–17.

Church, Tim R, Joe Brandon, and Galen R. Burgett
2001 GIS Applications in Archaeology: Method in Search of Theory. In *Practical Applications of GIS in Archaeology: A Predictive Modeling Toolkit with CDROM*, edited by K. Wescott, pp. 135–155. Taylor & Francis, London.

Coe, Michael
2005 *The Maya*, Seventh Edition. Thames & Hudson, New York.

Coggins, Clemency C.
1980 The Shape of Time: Some Political Implications of a Four-Part Figure. *American Antiquity* 45:727–739.

Collins, Lisa Marie
2002 The Zooarchaeology of the Copán Valley: Social Status and the Search for a Maya Slave Class. Unpublished Ph.D. Dissertation, Harvard University, Cambridge.

Cowgill, George
2004 Origins and Development of Urbanism: Archaeological Approaches. *Annual Review of Anthropology* 33: 525–549.

Crown, Patricia L., and Timothy A. Kohler
1994 Community Dynamics, Site Structure, and Aggregation in the Northern Rio Grande. In *The Ancient Southwestern community, models and methods for the study of prehistoric social organization*, ed. W. Wills and R. Leonard, pp103–117, University of New Mexico Press, Albuquerque.

Cutting, Marion
2003 The Use of Spatial Analysis to Study Prehistoric Settlement Architecture. *Oxford Journal of Archaeology* 22(1):1–21.
2006 More than One Way to Study a Building: Approaches to Prehistoric Household and Settlement Space. *Oxford Journal of Archaeology* 25(3): 225–246.

Daly, Patrick, and Thomas L. Evans
2006 Introduction: Archaeological theory and digital pasts. In *Digital Archaeology: Bridging Method and Theory*, edited by P. Daly and T. Evans, pp. 3–9. Routledge, Taylor and Francis, New York and London.

Daly, Patrick, and Gary Lock
2004 Time, Space, and Archaeological Landscapes: Establishing Connections in the First Millenium BC. In *Spatially Integrated Social Science*, edited by M. Goodchild and D. Janelle, pp. 349–635. Oxford University Press, Oxford.

Davis-Salazar, Karla L.
2001 Late Classic Maya Water Management at Copán, Honduras. Unpublished Ph.D. Dissertation, Department of Anthropology, Harvard University, Cambridge.
2003 Late Classic Maya Water Management and Community Organization at Copán, Honduras. *Latin American Antiquity* 14:275–299.

Demarest, Arthur
1987 Recent Research on the Preclassic Ceramics of the Southeastern Highlands and Pacific Coast of Guatemala. In *Maya Ceramics: Papers from the 1985 Maya Ceramic Conference*, editors p. Rice and R. Sharer, pp. 329–339. British Archaeological Reports 345. BAR International Series, Oxford.
1996 Concluding Comment on the Maya State: Centralized or Segmentary? *Current Anthropology* 37: 821–824.
2004 *Ancient Maya: The Rise and Fall of a Rainforest Civilization*. Cambridge University Press, Cambridge.

DeMarrais, Elizabeth, Luis Jaime Castillo, and Timothy Earle
1996 Ideology, Materialization, and Power Strategies. *Current Anthropology* 37(1): 15–31.

Douglass, J. G.
2000 *Hinterland Households: Rural Agrarian Household Diversity in Northwest Honduras*. University Press of Colorado, Boulder.

Dreyfus, Hubert L., and Paul Rabinow
1983 *Michel Foucault: Beyond Structuralism and Hermeneutics*. University of Chicago Press, Chicago.

Durkheim, Emile, and Marcel Mauss
1963 Primitive Classification. University of Chicago Press, Chicago.

Eco, Umberto
1986 Function and Sign: Semiotics of Architecture. In *The City And The Sign: An Introduction To Urban Semiotics*, edited by M. Gottdiener and A. Lagopoulos pp. 55–86. Columbia University Press, New York.

Esqueda, Marcela
2009 *Crafting Identity: A Case Study of Community Integration through Pottery Production in Northwestern Honduras*. Paper presented at 74th Annual Society for American Archaeology Meeting, April 24, 2009, Atlanta, Georgia.

Fash, Barbara
2004 Early Classic Sculptural Development at Copan. In *Understanding Early Classic Copan,* edited by E. Bell, M. Canuto, and R. Sharer, pp. 249–263. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.
2005 Iconographic Evidence for Water Management and Social Organization at Copán. In *Copán: The History of an Ancient Kingdom*, edited by E.W. Andrews and W. Fash, pp. 103–138. School of American Research Advanced Seminar Series, Santa Fe.

Fash, Barbara, and Karla Davis-Salazar
2006 Copan Water Ritual and Management: Imagery and Sacred Place. In *Precolumbian Water Management*, edited by L. Lucero and B. Fash, pp. 129–143. University of Arizona Press, Tucson.

Fash, Barbara, W. Fash, S. Lane, C. Larios, L. Schele, J. Stomper, and D. Stuart
1992 Investigations of a Classic Maya Council House at Copan, Honduras. *Journal of Field Archaeology* 19:419–442.

Fash, William L.
1983a Maya State Formation: A Case Study and Its Implications. Unpublished Ph.D. Dissertation, Department of Anthropology, Harvard University, Cambridge.
1983b Deducing Social Organization from Classic Maya Settlement Patterns: A Case Study from the Copán Valley. In *Civilization in the Ancient Americas: Essays in Honor of Gordon R. Willey*, edited by R. Leventhal and A. Kolata, pp. 261–288. University of New Mexico Press, Albuquerque.
1988 A New Look at Maya Statecraft from Copan, Honduras. *Antiquity* 62:157–169.
1989 Sculptural Façade of Structure 9N-82: Content, Form, and significance. In *House of Bacabs, Copan, Honduras,* edited by D. Webster, pp. 41–72. Dumbarton Oaks Research Library and Collection, Washington D.C.
1991 Lineage Patrons and Ancestor Worship Among the Classic Maya Nobility: The Case of Copán Structure 9N-82. In *Sixth Palenque Round Table, 1986*, edited by M. Robertson, pp. 68–80. University of Oklahoma Press, Norman and London.

1998 Dynastic Architectural Programs: Intention and Design in Classic Maya Buildings at Copan and Other Sites. *In Function and Meaning in Classic Maya Architecture*, edited by S. Houston, pp. 223−270. Dumbarton Oaks, Washington, D.C.

2001 *Scribes, Warriors, and Kings: The City of Copan and the Ancient Maya*. Thames and Hudson, London.

Fash, William L., and Ricardo Agurcia Fasquelle

2005 Contributions and Controversies in the Archaeology and History of Copán. In *Copán: The History of an Ancient Maya Kingdom*, edited by E.W. Andrews and W. Fash, pp. 3−32. School of American Research Advanced Seminar Series, Santa Fe.

Fash, William L., E.W. Andrews, and T.K. Manahan

2004a Political Decentralization, Dynastic Collapse, and the Early Postclassic in the Urban Center of Copán, Honduras. In *The Terminal Classic Maya Lowlands: Collapse, Transition, and Transformation*, edited by A. Demarest, P. Rice, and D. Rice, pp.260−287. University Press of Colorado, Boulder.

Fash, William, and Barbara Fash

1996 Building a World-View: Visual Communication in Classic Maya Architecture. *RES* 29/30:127−147. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge.

2009 *What about Bob? Conjunctive Conjuring of K'uk' Mo' and Copan-Quirigua Connections.* Paper presented at 74th Annual Society for American Archaeology Meeting, April 25, 2009, Atlanta, Georgia.

Fash, William L., Barbara W. Fash, and Karla L. Davis-Salazar

2004b Setting the Stage: Origins of the Hieroglyphic Stairway Plaza on the Great Period Ending. In *Understanding Early Classic Copan*, edited by E. Bell, M. Canuto, and R. Sharer, pp. 65−83. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Fash, William, and K. Long

1983 Mapa Arqueologico del Valle de Copán. *Introducción a la Arqueología de Copán, Honduras*. Proyecto Arqueologico Copán, Secretaria de Estado en el Despacho de Cultura y Turismo, Tegucigalpa, D.C.

Fash, William, and Robert Sharer

1991 Sociopolitical Developments and Methodological Issues at Copán, Honduras: A Conjunctive Perspective. *Latin American Antiquity* 2(2): 166-187.

Fash, William, and David Stuart
1991 Dynastic History and Cultural Evolution at Copan, Honduras. In *Classic Maya Political History: Hieroglyphic and Archaeological Evidence*, edited by T. Patrick Culbert, pp. 147–179. Cambridge University Press, Cambridge.

Fash, William L., Richard V. Williamson, Carlos Rudy Larios, and Joel Palka
1992 The Hieroglyphic Stairway and its Ancestors: Investigations of Copan Structure 10L-26. *Ancient Mesoamerica* 3:105–115.

Ferguson, T.J.
1996 *Historic Zuni architecture and society: an archaeological application of space syntax.* University of Arizona Press, Tucson.

Fisher, Peter F.
1999 Geographical Information Systems: Today and Tomorrow? In *The Archaeology of Mediterranean Landscapes 3: Geographical Information Systems and Landscape Archaeology*, edited by M. Gillings, D. Mattingly, and J. van Dalen, pp.5–11. Oxbow Books, Oakville.

Fletcher, Roland
1981 People and Space: A Case Study on Material Behavior. In *Pattern of the Past: Studies in Honour of David Clarke,* edited by I. Hodder, G. Issac, and N. Hammond, pp. 97–128. Cambridge University Press, Cambridge.

Foucault, Michel
1979 *Discipline and Punish: The Birth of the Prison*. Vintage Books, New York.

Freidel, David A.
1981 The Political Economics of residential Dispersion Among the Lowland Maya. In *Maya Lowland Settlement Patterns*, edited by W. Ashmore, pp. 371–382.University of New Mexico Press, Albuquerque.

Freidel, David A., and Linda Schele
1988 Kingship in the Late Preclassic Maya Lowlands: The Instruments and Places of Ritual Power. *American Anthropologist* 90:547–567.

Freter, AnnCorinne
1988 The Classic Maya Collapse at Copán, Honduras: A Regional Settlement Perspective. Unpublished Ph.D. Thesis, Department of Anthropology, University Park, Pennsylvania State University.
1992 Chronological Research at Copan: methods and implications. *Ancient Mesoamerica* 3:117–133.
1994 The Classic Maya Collapse at Copan, Honduras: An Analysis of Maya Rural Settlement Trends. In *Archaeological Views from the Countryside*, edited by

Glenn M. Schwartz and Steven E. Falconer, pp. 160–176. Smithsonian Institution Press, Washington and London.
2004 Multiscalar Model of Rural Households and Communities in Late Classic Copan Maya Society. *Ancient Mesoamerica* 15:93–106.

Galindo, Juan
1836 Letters to the King: The Ruins of Copan. In *Transactions and collections of the American Antiquarian Society*, pp. 543–550. American Antiquarian Society, Worcester.

Gardin, Jean-Claude
1992 Semiotic Trends in Archaeology. In *Representations in Archaeology*, edited by Jean-Claude Gardin and Christopher S. Peebles, pp. 87–104. Indiana University Press, Bloomington.

Gardin, Jean-Claude, and Christopher S. Peebles
1992 Introduction. In *Representations in Archaeology*, edited by Jean-Claude Gardin and Christopher S. Peebles, pp. 1–11. Indiana University Press, Bloomington.

Gellar, Pamela
2004 Transforming Bodies, Transforming Identities: A Consideration of Pre-Columbian Maya Corporeal Beliefs and Practices (Belize). Unpublished Ph.D. Dissertation, University of Pennsylvania, Philadelphia.

Gerstle, Andrea I.
1987 Ethnic Diversity and Interaction at Copan, Honduras. In *Interaction on the Southeast Mesoamerican Frontier*, edited by E. J. Robinson, pp. 462. vol. ii. BAR International Series 327.
1988 Maya-Lenca Ethnic Relations in Late Classic Period Copan, Honduras. Unpublished Ph.D. Dissertation, Department of Anthropology, Pennsylvania State University.

Giddens, Anthony
1979 *Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis*. University of California Press, Berkeley.
1984 *The Constitution of Society: Outline of the Theory of Structuration*. University of California Press, Berkeley.

Glowacki, Mary, and Michael Malpass
2003 Water, Huacas, and Ancestor Worship: Traces of a Sacred Wari Landscape. *Latin American Antiquity* 14(4):431–448.

Goffman, Erving
1983 *Forms of Talk*. University of Pennsylvania Press: Philadelphia.

Gonlin, Nancy
1994 Rural household diversity in Late Classic Copán, Honduras. In *Archaeological Views from the Countryside,* edited by G. Schwartz and S. Falconer, pp.177–197. Smithsonian Institution Press: Washington and London.
2007 Ritual and Ideology Among Classic Maya Rural Commoners at Copán, Honduras. In *Commoner Ritual and Ideology in Ancient Mesoamerica*, edited by N. Gonlin and J. Lohse, pp. 83–121. University Press of Colorado, Boulder.

Gonlin, Nancy and Jon Lohse (editors)
2007 *Commoner Ritual and Ideology in Ancient Mesoamerica*. University Press of Colorado, Boulder.

Gordon, G.B.
1896 *Prehistoric Ruins of Copán, Honduras*. Harvard University, Cambridge.

Gottdiener, Mark, and Alexandros Lagopoulos
1986 *The City and the Sign: An Introduction to Urban Semiotics.* Columbia University Press, New York.

Guillermin, G.F.
1968 Development and Function of the Tikal Ceremonial Center. *Ethnos* 33:1–35.

Hall, Edward T.
1966 *The Hidden Dimension*. Doubleday Books, New York.

Hall, Jay, and René Viel
2004 The Early Copan Classic Landscape: A View from the Preclassic. In Understanding *Early Classic Copan*, pp. 17–28. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Hammond, Norman and Gair Tourtellot
1999 *Shifting Axes: Spatial Expressions of Power at La Milpa*. Paper presented at the 64th Annual Meeting, Society for American Archaeology. Chicago, IL. March 27th.

Hanks, William F.
1990 *Referential Practice: Language and Lived Space among the Maya*. The University of Chicago Press, Chicago and London.

Harrison, Peter
1999 *The Lords of Tikal: Rulers of an Ancient Maya City*. Thames and Hudson, New York.

Haviland, William A.
1981 Dower Houses and Minor Centers at Tikal, Guatemala: An Investigation into the Identification of Valid Units in Settlement Hierarchies. In *Lowland Maya Settlement Patterns*, edited by W. Ashmore, pp. 89–117. University of New Mexico Press, Albuquerque.

Hendon, Julia
1987 The Uses of Maya Structures: A Study of Architecture and Artifact Distribution at Sepulturas, Copán, Honduras. Unpublished Ph.D. Dissertation, Department of Anthropology, Harvard University, Cambridge.
1991 Status and Power in Classic Maya Society: An Archaeological Study. *American Anthropologist*, New Series Vol.93, No. 4 (Dec. 1991), pp. 894–918.

Heydon, Doris
1981 Caves, Gods, and Myths: World-View and Planning in Teotihuacan. In *Mesoamerican Sites and World Views*, edited by E. Benson, pp. 1–40. Dumbarton Oaks Research Library and Collection, Washington D.C.

Higuchi, Tadahiko
1983 *The Visual and Spatial Structures of Landscapes.* The MIT Press, Cambridge and London.

Hillier, Bill
1996 *Space is the Machine: a configurational theory of architecture*. Cambridge University Press, Cambridge and New York.
1999 The common language of space: a way of looking at the social, economic, and environmental functioning of cities on a common basis. *Journal of Environmental Sciences* 11(3):344–349.

Hillier, Bill and Julienne Hanson
1984 *The social logic of space*. Cambridge University Press, Cambridge and New York.

Hillier, Bill, A. Penn, J. Hanson, T. Grajewski, and J. Xu
1993 Natural movement: or, configuration and attraction in urban pedestrian movement. *Environment and Planning B: Planning and Design* 20:29–66.

Hodder, Ian
1986 *Reading the Past: Current Approaches to Interpretation in Archaeology*. Cambridge University Press, Cambridge.
1992 *Theory and Practice in Archaeology (Material Cultures).* Routledge, New York.
1994 Burials, Houses, Women and Men in the European Neolithic. In *Ideology, Power, and Prehistory*, edited by D. Miller and C. Tilley. Cambridge University Press, Cambridge.
.

Hohmann, Hasso
1995 *Die Architektur Der Sepulturas-Region Von Copán In Honduras*. Academic Publishers: Graz.

Hohmann, Hasso, and Annegrete Vogrin
1982 *Die Architektur Von Copan*. Academic Publishers, Graz.

Houk, Brett
1996 The Archaeology of Site Planning: An Example from the Maya site of Dos Hombres, Belize. Unpublished Ph.D. Dissertation: University of Texas, Austin.

Houston, Stephen D.
1998 Finding Function and Meaning in Classic Maya Architecture. In *Function and Meaning in Classic Maya Architecture*, edited by S. Houston, pp. 519−538. Dumbarton Oaks Research Library and Collection: Washington D.C.

Houston, Stephen, David Stuart, and Karl Taube
2006 *The Memory of Bones: Body, Being, and Experience among the Classic Maya.* University of Texas, Austin.

Inomato, Takeshi, and Stephen Houston (editors)
2001 *Royal Courts of the Ancient Maya*. Volumes I & II. Westview Press, Boulder CO.

Jakobson, Roman
1980 *The Framework of Language*. University of Michigan, Ann Arbor.

Joyce, Rosemary A., and Julia A. Hendon
2000 Heterarchy, History, and Material Reality: "Communities" in Late Classic Honduras. In *The Archaeology of Communities: A New World Perspective*, edited by M. Canuto and J. Yaeger, pp. 143−160. Routledge, London and New York.

Kantner, John
2004 Geographical Approaches for Reconstructing Past Human Behavior from Prehistoric Roadways. In *Spatially Integrated Social Science*, edited by M. Goodchild and D. Janelle, pp. 232−348. Oxford University Press, Oxford.

Kelemen, Pal
1946 Pre-Columbian Art and Art History. *American Antiquity* 11(3):145−154.

Kent, Susan
1984 *Analyzing Activity Areas: An Ethnoarchaeological Study of the Use of Space*. University of New Mexico Press, Albuquerque.

King, Anthony D.
1980 A time for space and a space for time: the social production of the vacation house. In *Buildings and Society: Essays on the Social Development of the Built Environment*, edited by A. King, pp. 193−227. Routledge & Kegan Paul, London.

Knowles, Caroline, and Paul Sweetman (editors)
2004 *Picturing the Social Landscape: Visual Methods and the Sociological Imagination*. Routledge, Taylor and Francis, London and New York.

Koontz, Rex, Kathryn Reese-Taylor, and Annabeth Headrick (editors.)
2001 *Landscape and Power in Ancient Mesoamerica*. Westview Press, Boulder.
Kowalski, Jeff Karl, and William L. Fash
1991 Symbolism of the Maya Ball Game at Copán: Synthesis and New Aspects. In *Sixth Palenque Round Table, 1986*, edited by Merle Greene Robertson, pp. 59−67. University of Oklahoma Press, Norman and London.

Kubler, George
1962 *The Art and Architecture of Ancient Americas: The Mexican, Maya, and Andean Peoples.* Yale University Press, New Haven.

Kurjack, Edward B.
1974 Preshistoric Lowland Maya Community and Social Organization. In *Middle American Research Institute, Publication 38*. Tulane University, New Orleans.

Kurjack, Edward B., and Silvia Garza T.
1981 Precolumbian Community Form and Distribution in the Northern Maya Area. In *Lowland Maya Settlement Patterns*, edited by W. Ashmore, pp. 287−209. University of New Mexico Press: Albuquerque.

Landau, Kristin
2009 *Re-analysis of Ceramics from Groups 10E-6 ("Ostuman") and 11E-2 ("Lost Mangos").* Informe submitted to Centro Regional de Investigaciones Arqueologicas, Instituto Hondureño de Antropología e Historia, Copan, Honduras.

Laughlin, Robert
1969 The Tzotzil. In *Handbook of Middle American Indians, vol. 7*, edited by E. Vogt. University of Texas Press, Austin, TX.

Lawrence, Denise L. and Setha M. Low
1990 The Built Environment And Spatial Form. *Annual Review O0f Anthropology* 19:453−505.

Lentz, David L.
1991 Maya Diets of the Rich and Poor: Paleoethnobotanical Evidence from Copan. *Latin American Antiquity* 2(3):269–287.

Leone, Mark
1984 Interpreting ideology in historical archaeology: using the rules of perspective in the William Paca Garden in Annapolis, Maryland. In *Ideology, Power, and Prehistory*, edited by Daniel Miller and Christopher Tilley, pp. 25–35. Cambridge University Press, Cambridge.

Leventhal, Richard
1979 Settlement Patterns at Copan, Honduras. Unpublished Ph.D. Dissertation, Department of Anthropology, Harvard University, Cambridge.
1981 Settlement Patterns in the Southeast Maya Periphery. In *Lowland Maya Settlement Patterns*, edited by W. Ashmore, pp. 187–209. School of American Research Advanced Seminar Series. University of New Mexico Press, Albuquerque.
1983 Household Groups and Classic Maya Religion. In *Prehistoric Settlement Patterns: Essays in Honor of Gordon R. Willey*, edited by E. Vogt and R. Leventhal, pp. 55–76. University of New Mexico Press and Peabody Museum of Archaeology and Ethnology, Harvard University

Lévi–Strauss, Claude
1963 *Structural Anthropology.* Doubleday Anchor Books, Garden City, New Jersey.

Llobera, Marcos
1996 Exploring the topography of the mind: GIS, social space and archaeology. *Antiquity* 70(260):121–133.
2000 Understanding Movement: a pilot model towards the sociology of movement. In *Beyond the Map: Archaeology and Spatial Technologies*, edited by G. Lock, pp. 65–84. IOS Press, Amsterdam.
2001 Building Past Landscape Perception With GIS: Understanding Topographic Prominence. *Journal of Archaeological* Science 28:1005–1014.
2003 Extending GIS Based Analysis: The Concept of the Visualscape. *International Journal of Geographic Information Science* 1(17):25–48.
2006 What you see is what you get?: Visualscapes, visual genesis and hierarchy. In *Digital Archaeology: Bridging Method and Theory*, edited by P. Daly and T. Evans, pp. 148–167. Routledge, Taylor and Francis, New York and London.

Lock, Gary and Trevor Harris
2000 Beyond the Map: Archaeology and Spatial Technologies. In *Beyond the Map: Archaeology and Spatial Technologies*, edited by G. Lock, pp. xiii-xxv. IOS Press, Amsterdam.

Lohse, Jon C.
2007 Commoner Ritual, Commoner Ideology: (Sub-)Alternative Views of Social Complexity in Prehispanic Mesoamerica. In *Commoner Ritual and Ideology in Ancient Mesoamerica*, edited by N. Gonlin and J. Lohse, pp. 1−32. University Press of Colorado, Boulder.

Longley, Paul, Michael Goodchild, David Maguire, and David Rhind
2005 *Geographic Information Systems and Science*. Wiley Press, Barcelona.

Longyear, J. M. III
1952 Copán Ceramics: A Study of Southeastern Maya Pottery. Carnegie Institution of Washington, Washington, D.C.

Lucero, Lisa
2007 Classic Maya Temples, Politics, and the Voice of the People. *Latin American Antiquity* (18) 4:407−427.

Lynch, Kevin
1960 *The Image of the City*. MIT Press, Cambridge.

Maca, Allan Leigh Jr.
2002 Spatio-temporal boundaries in Classic Maya settlement systems: Copan's urban foothills and the excavations at Group 9J-5. Unpublished Ph.D. Dissertation, Department of Anthropology, Harvard University, Cambridge.
2009 Ethnographic Analogy and the Archaeological Construction of Maya Identity at Copan, Honduras. In *Cho'rti' Maya Area: Past and Present*, edited by B. Metz, C. McNeil, and K. Hull , pp. 90−107. University Press of Florida, Gainesville.

Maca, Allan, and Katherine Miller
2009 *Copan's Q'eqch'i Barrio?* Paper presented at 74th Annual Society for American Archaeology Meeting, April 22−26, 2009, Atlanta, Georgia.

Maca, Allan, and Marc Wolf
2001 GIS Map of the Northern Foothills, Copán. Copán.

Mallory, John K.
1984 The Place of Obsidian in the Economy of Copan. Unpublished Ph.D. Dissertation, Department of Anthropology, Pennsylvania State University, University Park.

Manahan, T. Kam
2003 The collapse of complex society and its aftermath: a case study from the classic Maya site of Copán, Honduras. Unpublished Ph.D. Dissertation, Vanderbilt University, Brentwood.

2004 The Way Things Fall Apart: Social organization and the Classic Maya collapse. *Ancient Mesoamerica* 15:107–125.

Manahan, T. Kam, and Marcello Canuto
2009 Bracketing the Copan Dynasty: Late Preclassic and Early Postclassic Settlements at Copan, Honduras. *Latin American Antiquity* 20(4):553–580.

Maples, Stace D.
2004 *Characterizing the Visual Landscape of the Chaves/Hummingbird Site*. Paper presented at the University of Texas at Dallas GIS Workshop, July 24, 2004.

Marcus, Joyce
1976 *Emblem and State in the Classic Maya Lowlands: An Epigraphic Approach to Territorial Organization*. Dumbarton Oaks, Washington, D.C.
1983 On the Nature of the Mesoamerican City. In *Prehistoric Settlement Patterns: Essays in Honor of Gordon R. Willey*, edited by R. Leventhal and E. Vogt, pp. 195–242. University of New Mexico Press and Peabody Museum of Archaeology and Ethnology, Harvard University
1992 Royal Families, Royal Texts: Examples from the Zapotec and Maya. In *Mesoamerican Elites: An Archaeological Assessment*, edited by D. Chase and F. Chase, pp. 221–241. University of Oklahoma Press, Norman
2000 Toward an Archaeology of Communities. In *The Archaeology of Communities: A New World Perspective*, edited by M. Canuto and J. Yaeger, pp. 231–242. Routledge, London and New York.

Maudslay, Anne Cary, and Alfred Percival Maudslay
1992 *A Glimpse at Guatemala and Some Notes on the Ancient Monuments of Central America*. Flo Silver Books, Indianapolis.

McAnany, Patricia
1995 *Living with the Ancestors: Kinship and Kingship in Ancient Maya Society*. University of Texas Press, Austin.

McAnany, Patricia, and Shannon Plank
2001 Perspectives on Actors, Gender Roles, and Architecture at Classic Maya Courts and Households. In *Royal Courts of the Ancient Maya: Theory, Comparison, and Synthesis, Volume 1*, edited by T. Inomata and S. Houston, pp. 84–129. Westview Press, Boulder.

McNeil, Cameron
2009 The Environmental Record of Human Populations and Migrations in the Copán Valley, Honduras. In *Cho'rti' Maya Area: Past and Present*, edited by B. Metz, C. McNeil, and K. Hull , pp. 47–60. University Press of Florida, Gainesville.

McPherron, Shannon P., and Harold L. Dibble
2002 *Using Computers in Archaeology: A Practical Guide*. McGraw-Hill Mayfield, Boston.

Messenger, L.
1987 Community Organization of the Late Classic Southern Periphery of Mesoamerica: "Expressions of Affinity". In *Interaction on the Southeast Mesoamerican Frontier: Prehistoric and Historic Honduras and El Salvador*, edited by E. J. Robinson, pp. 385−420. BAR International Series 327 (ii).

Miller, Mary Ellen, and Stephen Houston
1987 Classic Maya Ballgame and its Architectural Setting. *RES* 14:46-65.

Moore, Jerry D.
1996a *Architecture and Power in the Ancient Andes: The Archaeology of Public Buildings*. Cambridge University Press, Cambridge.
1996b The Archaeology of Plazas and the Proxemics of Ritual: Three Andean Traditions. *American Anthropologist*, 98(4):789−802.
2003 Life behind Walls: Patterns in the Urban Landscape on the Prehistoric North Coast of Peru. In *The Social Construction of Ancient Cities*, edited by M. L. Smith, pp. 81−102. Smithsonian Books, Washington and London.
2005 *Cultural Landscapes in the Ancient Andes: Archaeologies of Place*. University Press of Florida, Gainesville.

Morgan, Lewis H.
1965 *House and House-Life of the American Aborigines*. University of Chicago Press, Chicago. (Orig. published 1881).

Morley, Sylvanus Griswold
1920 *The Inscriptions at Copan*. Carnegie Institution of Washington Publication, No. 219, Washington, D.C.

Morris, Charles
1946 *Signs, Language and Behavior*. Prentice-Hall, New York.

Nakamura, Seiichi, Kazuo Aoyama, and Eiji Uratsuji
1991 *Investigaciones Arqueológicas en la Región de la Entrada, Primera Fase*. San Pedro Sula.

Newsome, Elizabeth
2001 *Trees of Paradise and Pillars of the World: the serial stelae cycle "18-Rabbit-God K," King of Copan*. University of Texas Press:, Austin.

Ogburn, Dennis E.
2006 Assessing the level of visibility of cultural objects in past landscapes. *Journal of Archaeological Science* 33:405–103.

Orr, Heather
2001 Procession Rituals and Shrine Sites: The Politics of Sacred Space in Late Formative Valley of Oaxaca. In *Landscape and Power in Ancient Mesoamerica*, edited by R. Koontz, K. Reese-Taylor and A. Headrick, pp.55–80. Westview Press, Boulder.

Paine, Richard R., and AnnCorinne Freter
1996 Environmental Degradation and the Classic Maya Collapse at Copan, Honduras (A.D. 600-1250): Evidence from Studies of Household Survival. *Ancient Mesoamerica* 7:37–47.

Parmentier, Richard J.
1987 *The Sacred Remains: Myth, History, and Polity in Belau*. The University of Chicago Press, Chicago and London.
1997 The Pragmatic Semiotics of Cultures. *Semitoica* Vol. 116, pp. 1–115.

Pearson, Michael Parker, and Colin Richards (editors)
1994 *Architecture and Order: Approaches to Social Space*. Taylor & Francis, New York.

Peirce, Charles Sanders
1966 *Collected Papers, Volumes 1–8*, edited by C. Hartshorne and P. Weiss. Belknap Press of Harvard University Press, Cambridge.

Plank, Shannon
2003 Monumental Maya Dwellings in the Hieroglyphic and Archaeological Records: A Cognitive-Anthropological Approach to Classic Maya Architecture. Unpublished Ph.D. Dissertation, Boston University, Boston.
2004 Maya Dwellings in Hieroglyphs and Archaeology. *BAR International Series* 1324. Oxford, England.

Pollock, Harry
1965 Architecture of the Maya Lowlands. In *Handbook of Middle American Indians,* edited by G. Willey, pp. 378–440. University of Texas Press, Austin.

Preucel, Robert W.
2000 Making Pueblo Communities: Architectural Discourse at Kotyiti, New Mexico. In *The Archaeology of Communities: A New World Perspective*, edited by M. Canuto and J. Yaeger, pp. 58–77. Routledge, London and New York.

Preucel, Robert W., and Alexander A. Bauer
2001. Archaeological Pragmatics. In *Norwegian Archaeological Review*, 34(2):85−96.

Preziosi, Donald
1979a *The Semiotics of the Built Environment: An Introduction to Architectonic Analysis*. Indiana University Press, Bloomington & London.
1979b Architecture, Language, and Meaning: The Origins of the Built World and its Semiotic Organization. In *Approaches to Semiotics* Vol. 49. Mouton Publishers, New York.

Price, T. Douglas, J. Burton, P. Fullagar, L. Wright, J. Buikstra, and V. Tiesler
2008 87Sr/86Sr Ratios and the Study of Human Mobility in Ancient Mesoamerica. *Latin American Antiquity* 19(2):167−180.

Price, Douglas, James Burton, Robert Sharer, Jane Buikstra, Lori Wright, Loa Traxler, and Katherine Miller
2009 Kings and commoners at Copan: Isotopic evidence for origins and movement in the Classic Maya Period. *Journal of Anthropological Archaeology* 29(1):15−32.

Proskouriakoff, Tatiana
1963 *An Album of Maya Architecture*. Carnegie Institution of Washington Publication 558, Washington, D.C.
1973 The Hand-grasping-fish and Associated Glyphs on Clssic Maya Monuments. In *Mesoamerican Writing Systems: A Conference at Dumbarton Oaks, October 30th and 31st*, 1971, edited by E. Benton, p.p. 165−178.

Rapoport, Amos
1969 *House Form and Culture*. Prentice-Hall, Englewood Cliffs.
1988 Levels of Meaning in the Built Environment. In *Cross-Cultural Perspectives in Non-Verbal Communication*, edited by F. Poyatos, pp. 317−336. C.J. Hogrefe, Toronto.
1990 *The Meaning of the Built Environment*: A Nonverbal Communication Approach. Sage Publications, Beverly Hills.

Ratti, Carlo
2004 Space syntax: some inconsistencies. *Environment and Planning B: Planning and Design* 31:487−499.
2005 The lineage of the line: space syntax parameters from the analysis of urban DEMs. *Environment and Planning B: Planning and Design* 32:547−566.

Reents-Budet, Dorie
2001 Classic Maya Concepts of the Royal Court: An Analysis of Renderings on Pictorial Ceramics. In *Royal Courts of the Ancient Maya* Vol. 1, edited by T. Inomata and S. Houston, pp.195−233. Westview Press, Boulder, CO.

Reese-Taylor, Kathyrn
2001 Ritual Circuits as Key Elements in Maya Civic Center Designs. In *Heart of Creation: The Mesoamerican World and the Legacy of Linda Schele*, edited by Andrea Stone, pp. 143−165. The University of Alabama Press, Tuscaloosa and London.

Renfrew, Colin, and Paul Bahn
2005 *Archaeology: Theories, Methods and Practice*. Thames & Hudson, New York.

Rice, Prudence
2004 *Maya Political Science: Time, Astronomy, and the Cosmos*. University of Texas Press, Austin.

Richards, Heather M.
2003 *Deconstructing the Architectural Palimpsest at the Ancient Maya Center of Copan, Honduras*. Paper presented at the 68th Annual Meeting of the Society for American Archaeology, Milwaukee, April 5.

Richards-Rissetto, Heather M.
2008 *Using GIS to Study Ancient Social Interaction at Copán, Honduras*. SouthWest Users Group Conference (SWUG 2008), Laramie, Wyoming, October 23, 2008.
2007 Exploring Social Dynamics at the Ancient Site of Copán, Honduras. In *ESRI Professional Papers*, Paper 1475, San Diego, June 2007.

Riese, Berthold
1989 The Inscriptions of the Sculptured Bench of the House of the Bacabs. In *The House of the Bacabs, Copán, Hondruas*, edited by D. Webster, pp. 82−88. Dumbarton Oaks Research Library and Collection, Washington D.C.

Roys, Ralph
1943 *The Indian Background of Colonial Yucatan*. Carnegie Institution of Washington, Washington, D.C.

Rue, David J.
1987 Early Classic and early Postclassic Maya occupation in western Honduras. *Nature* 326:285−286.

Sabloff, Jeremy
1997 *The Cities of Ancient Mexico: Reconstructing a Lost World*. Thames & Hudson, Hong Kong.

Sanchez, Julia Lynn
1997 Royal Strategies and Audience: An Analysis of Classic Maya Monumental Art. Unpublished Ph.D. Dissertation. University of California, Los Angeles.

Sanders, William T.
1986 *Excavaciones en el area urbana de Copán, tomo I*. Instituto Hondureño de Antropología e Historia, Tegucigalpa.
1989 Household, Lineage, and State at Eighth-Century Copan, Honduras. In *The House of the Bacabs*, *Copan, Honduras*, edited by David Webster, pp. 89–105. Studies in Precolumbian Art and Archaeology, No. 29. Dumbarton Oaks, Washington DC.

Sanders, William, and David Webster
1981 Reconocimiento del Asentimiento del Valle de Copán. *Yaxkin* 4(2):85–99.
1988 The Mesoamerican Urban Tradition. *American Anthropologist* 90:521–546.

Saturno, William A., Thomas L. Sever, Daniel E. Irwin, Burgess F. Howell, and Thomas G. Garrison
2007 Putting Us on the Map: Remote Sensing Investigation of the Ancient Maya Landscape. In *Remote Sensing in Archaeology*, edited by J. Wiseman and F. El-Baz. Springer, New York.

Saturno, William A., Thomas L. Sever, Daniel E. Irwin, and Burgess F. Howell
2006 Regional Scale Landscape Archaeology: 21st Century Remote Sensing Technology and the Ancient Maya. In *Manual of Remote Sensing Vol. 5, Remote Sensing and Human Settlements*, edited by M. Ridd and J. Hiplle. John Wiley, Hoboken.

Saussure, Ferdinand de
1966 *Course in general linguistics*, edited by C. Bally and A. Sechehaye in collaboration with A. Riedlinger. McGraw-Hill Book Co, New York.

Schele, Linda
1992 The Founders of Lineage at Copan and Other Maya Sites. *Ancient Mesoamerica* 3: 135–144.

Schele, Linda and David A. Freidel
1990 *A Forest of Kings: The Untold Story of the Ancient Maya*. William Morrow, New York.

Schele, Linda, and Peter Matthews
1998 *The Code of Kings: The Language of Seven Sacred Maya Temples and Tombs*. Scribner, New York.

Schele, Linda, and Mary Ellen Miller
1996 *The Blood of Kings: Dynasty and Ritual in Maya Art*. George Braziller, New York.

Schele, Linda, David Stuart, and Nikolai Grube
1991 A Commentary on the Inscriptions of Structure 22A at Copán. *Copan Mosaics Project, Copan Note 98*.

Schortman, Edward M.
1993 Archaeological Investigations in the Lower Motagua Valley, Izabel, Guatemala: A Study in Monumental Site Function and Interaction. In *Quirigua Reports, Vol. 3,* Philadelphia.

2001 Politics with Style: Identity Formation in Prehispanic Southeastern Mesoamerica. *American Anthropologist* 103:312-330.

von Schwerin, Jennifer
manuscript accepted
The Sacred Mountain in Social Context: Symbolism and History in Maya Architecture—Temple 22 at Copán, Honduras. *Ancient Mesoamerica*.

Sedat, David W. and F. López
2004 Initial Stages in the Formation of the Copan Acropolis. In *Understanding Early Classic Copan*, edited by E. Bell, M. Canuto, and R. Sharer, pp. 85−99. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Shapiro, J. S.
2005 *A Space Syntax Analysis of Arroyo Hondo Pueblo, New Mexico Community Formation in the Northern Rio Grande*. School of American Research Press, Santa Fe.

Sharer, Robert
2004 External Interaction at Early Classic Copan. In *Understanding Early Classic Copan*, edited by E. Bell, M. Canuto, and R. Sharer, pp. 297−318. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Sharer, Robert, Julia Miller, and Loa Traxler
1992 Evolution of Classic Period Architecture in the Early Acropolis, Copan: A Progress Report. *Ancient Mesoamerica* 2:145−159.

Sharer, Robert, David W. Sedat, Loa P. Traxler, Julia C. Miller, and Ellen E. Bell
2005 Early Classic Royal Power in Copan: The Origins and Development of the Acropolis (ca. A.D. 250-600). In *Copán: The History of an Ancient Maya Kingdom*, edited by E.W. Andrews and W. Fash, pp. 139−200. School of American Research Advanced Seminar Series, Santa Fe.

Silverstein, Michael
1976 Shifters, Linguistic Categories, and Cultural Description. In *Meaning in Anthropology*, edited by K. Basso and H. Selby, pp. 11−56. School of American Research Advanced Seminar Series, Santa Fe.

Smith, Adam T.
2003 *The Political Landscape: Constellations of Authority in Early Complex Polities*. University of California Press, Berkeley and Los Angles.

Smith, Michael E.
2003 Can We Read Cosmology in Ancient Maya City Plans? Comment on Ashmore and Sabloff. *Latin American Antiquity*, 14(2):221−228.
2007 Form and Meaning in the Earliest Cities: A New Approach to Ancient Urban Planning. *Journal of Planning History*, 6(1):3−47.

Sosa, J.
1985 Maya Sky, Maya World: A Symbolic Analysis of Yucatec Maya Cosmology. Unpublished Ph.D. Dissertation, Department of Anthropology. State University of New York, Albany.

Spiden, Herbert J.
1913 *A Study of Maya Art: Its Subject Matter and Historical Development*. Dover Publications: New York.

Spink, M.
1983 Metates as Socioeconomic Indicators During the Classic Period at Copan. Unpublished Ph.D. Dissertation, Department of Anthropology, Pennsylvania State University, University Park.

Squier, Ephraim G.
1985 *Letter to the King of Spain by Diego García de Palacio*. Translated and with notes by Ephraim G. Squier. Labyrinthos. Culver City, California.

Stephens, John Lloyd
1969 *Incidents of Travel in Central America, Chiapas and Yucatan*, *Volume I*. Dover Publications, New York. (Originally published in 1841).

Stomper, Jeffrey A.
2001 A model for late classic community structure at Copán, Honduras. In *Landscape and Power in Ancient Mesoamerica*,edited by R. Koontz, K. Reese-Taylor and A. Headrick. Westview Press, Boulder.

Storey, Rebecca
1992 The Children of Copan: Issues in Paleopathology and Paleodemography. *Ancient Mesoamerica* 3:161−167.

1997 Individual Frailty, Children of Privilege, and Stress in Late Classic Copán. In *Bones of the Maya: Studies of Ancient Skeletons*, edited by S. Whittington and D. Reed, pp. 116−126.

Stuardo, Rodrigo Liendo
2003 Access Patterns in Maya Royal Precincts. In *Maya Palaces and Elite Residences: An Interdisciplinary Approach*, edited by Jessica Joyce Christie, pp. 184−203. University of Texas Press, Austin.

Stuart, David
1989 Comments on the Temple 22 Inscription. *Copán Note 63*. Copán, Honduras: Copán Acropolis Archaeology Project and the Instituto Hondureño de Antropología e Historia.
1992 Hieroglyphs and Archaeology at Copan. *Ancient Mesoamerica* 3:169−184.
2004 The Beginnings of the Copan Dynasty: A Review of the Hieroglyphic and Historical Evidence. In *Understanding Early Classic Copan*, edited by E. Bell, M. Canuto, and R. Sharer, pp. 215−247. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.
2007 The Origins of Copán's Founder. Posted on Maya Decipherment: A Weblog on the Ancient Maya Script. http://decipherment.wordpress.com/

Tate, Carolyn E.
1992 *Yaxchilan: The Design of a Maya Ceremonial City*. University of Texas Press, Austin.

Taylor, Walter
1948 *A Study of Archaeology*. American Anthropological Association, Menasha, WI.

Tedlock, Dennis
1996 *Popol Vuh: The Mayan Book of the Dawn of Life*. Simon & Schuster, New York.

Thompson, J.E.S.
1970 Maya History and Religion. *Civilizations of the American Indian Series,* 99. University of Oklahoma Press, Norman.

Tourtellot, Gair III
1983 An Assessment of Classic Maya Household Composition. In *Prehistoric Settlement Patterns: Essays in Honor of Gordon R. Willey*, edited by E. Vogt and R. Leventhal, pp. 35−54. University of New Mexico Press and Peabody Museum of Archaeology and Ethnology, Harvard University.
1988 *Excavations at Seibal, Department of Peten, Guatemala: Peripheral Survey and Excavation, Settlement and Community Patterns*. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge.

Tourtellot, Gair, Gloria Everson, and Norman Hammond
2003 Suburban Organization: Minor Centers at La Milpa, Belize. In *Monograph 49 of the Cotsen Institute of Archaeology, UCLA, 2003*, pp. 93−107.

Tourtellot, Gair, Jason Gonzalez, and Francisco Estrada Belli
1999 *Land and People at La Milpa, Belize*. Paper presented at the 64th Annual Meeting, Society for American Archaeology. Chicago, IL. March 27th.

Traxler, Loa
2001 The Royal Court of Early Classic Copan. In *Royal Courts of the Ancient Maya: Data and Case Studies, Volume 2*, edited by T. Inomata and S. Houston, pp. 46−73. Westview Press, Boulder.
2003 At Court in Copan: Palace Groups of the Early Classic. In *Maya Palaces and Elite Residences: An Interdisciplinary Approach*, edited by J. Christie, pp. 46-68. University of Texas Press, Austin.
2004a Evolution and Social Meaning of Patio and Courtyard Group Architecture of the Early Classic Acropolis. Unpublished PhD Dissertation, University of Pennsylvania, Philadephia.
2004b Redesigning Copan: Early Architecture of the Polity Center. In *Understanding Early Classic Copan*, edited by E. Bell, M. Canuto, and R. Sharer, pp. 53−63. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Trigger, Bruce
1989 *A History of Archaeological Thought*. Cambridge University Press, Cambridge.
1990 Monumental Architecture: A Thermodynamic Explanation of Symbolic Behavior. *World Archaeology*, 22(2), Monuments and the Monumental (Oct 1990), pp.119−132.
2006 *A History of Archaeological Thought*. Second Edition. Cambridge University Press, Cambridge.

Tschan, A.P., W. Raczkowski, and M. Latalowa
2000 Perception and viewsheds: are they mutually exclusive? In *Beyond the Map: Archaeology and Spatial Technologies*, edited by G. Lock, pp. 28-48. IOS Press: Amsterdam.

Tuan, Yi-Fu
1977 *Space and Place: The Perspective of Experience*. University of Minnesota Press, Minneapolis and London.

Turner, B.L. II, W. Johnson, G. Mahood, F.M. Wiseman, and J. Poole
1983 Habitat y agricultura en la region de Copán. In *Introducción a la Arquelolgía de Copán, Honduras*, tomo I, edited by C. Baudez, pp.35−142. Secretaría de Estado en el Despacho de Cultura y Turismo, Tegucuigalpa

Van Leusen
2002 *Pattern to process: methodological investigations into the formation and interpretation of spatial patterns in archaeological landscapes*. Ph.D. Dissertation, Faculty of Arts, University of Groningen.

Vlcek, David T. William L. Fash
1986 Survey in the Outlying Areas of the Copan Region, and the Copan-Quirigua 'Connection'. In *The Southeast Maya Periphery*, edited by P. Urban and E. Schortman, pp. 102–113. University of Texas Press: Austin.

Vogt, Evon Z.
1969 *Zinacantan: A Maya Community in the Highlands of Chiapas*. The Belknap Press of Harvard University Press, Cambridge.
1983 Ancient and Contemporary Maya Settlement Patterns: A New Look from the Chiapas Highlands. In *Prehistoric Settlement Patterns: Essays in Honor of Gordon R. Willey*, edited by E. Vogt and R. Leventhal, pp. 89–114. University of New Mexico Press: Albuquerque and Peabody Museum of Archaeology and Ethnology, Cambridge.

Vogrin, Annegrete
1989 The Spatial Relationships of Monuments at Copán and Quiriguá. In *Memorias del Segundo Coloquio Internacional de Mayistas*. Vol. I, pp. 139–149. Universidad Nacional Autónoma de México, México.

Wagner, Elisabeth
2000 An alternative view on the meaning and function of Structure 10L-22A, Copan, Honduras. In *The Sacred and Profane: Architecture and Identity in the Maya Lowlands, 3rd European Maya Conference, University of Hamburg, November 1998*, edited by P. Colas and M. Schwaben, pp.25–48. A. Saurerwein, Germany.

Watanabe, John
2004 Some Models in a Muddle: Lineage and house in Classic Maya social organization. *Ancient Mesoamerica* 15:159–166.

Wauchope, Robert
1938 *Modern Maya Houses: A Study of Their Archaeological Significance.* Carnegie Institution of Washington, Washington, D.C.

Webster, David L.
1985 Recent Settlement Survey in the Copan Valley, Honduras. In *Journal of New World Archaeology* 5: 39–51.
1998 Classic Maya Architecture: Implications and Comparisons. In *Function and Meaning in Classic Maya Architecture*, edited by S. Houston, pp. 5–41. Dumbarton Oaks Research Library and Collection, Washington D.C.

2001 Spatial Dimensions of Maya Courtly Life: Problems and Issues. In *Royal Courts of the Ancient Maya: Volume 1 Theory, Comparison, and Synthesis*, edited by T. Inomata and S. Houston, pp.130–167. Westview Press, Boulder

2002 *The Fall of the Ancient Maya: Solving the Mystery of the Maya Collapse.* Thames and Hudson, New York.

2005 Political Ecology, Political Economy, and the Culture History of Resource Management at Copán. In *Copán: The History of an Ancient Maya Kingdom*, edited by E. Wyllys Andrews an W. Fash, pp. 33–72. School of American Research Advanced Seminar Series, Santa Fe.

Webster, David (editor)

1989 *The House of the Bacabs, Copan, Honduras*. Dumbarton Oaks Research Library and Collection, Washington, D.C.

Webster, David, Barbara Fash, Randolph Widnmer, and Scott Zeleznik

1998 The Skyband Group: Investigations of a Classic Maya Elite Residential Complex at Copan, Honduras. Journal of Field Archaeology 25(2):319-–343.

Webster, David L., and AnnCorinne Freter

1990 Settlement History and the Classic Collapse at Copan: A Redefined Chronological Perspective. *Latin American Antiquity* 1(1):66–85.

Webster, David L., AnnCorinne Freter, and Nancy Gonlin

2000 *Copán: The Rise and Fall of an Ancient Maya Kingdom*. Harcourt College Publishers, Fort Worth.

Webster, David L., and Nancy Gonlin

1988 Household remains of the humblest Maya. In *Journal of Field Archaeology* 15(2):169–190.

Webster, David L., William T. Sanders, and Peter van Rossum

1992 A Simulation of Copan Population History and Its Implications. *Ancient Mesoamerica* 3:185–197.

Wheatley, David and Mark Gillings

2000 Vision, Perception, and GIS: Developing Enriched Approaches to the Study of Archaeological Visibility. In *Beyond the Map*: *Archaeology and Spatial Technologies*, edited by G. Lock, pp. 1–28, IOS Press, Amsterdam.

Whincup, Tony

2004 Imaging the Intangible. In *Picturing the Social Landscape: Visual Methods and the Sociological Imagination*, edited by C. Knowles and P. Sweetman, pp. 79–92. Routledge, Taylor & Francis Group, London and New York.

Whittington, Stephen
1989 *El Proyecto Arqueológico Ostumán: Informe Preliminar*. Report submitted to the Instituto Hondureño de Antropología e Historia.

Whittington, Stephen L., and David M. Reed
1997 Commoner Diet at Copán: Insights from Stable Isotopes and Porotic Hyperostosis. In *Bones of the Maya: Studies of Ancient Skeletons*, edited by S. Whittington and D. Reed, pp. 157–170.

Willey, Gordon R.
1956 *Prehistoric Settlement Patterns in the New World*. Viking Fund Publications in Anthropology, Wenner–Gren Foundation, New York.
1997 Copán: Settlement, Politics, and Ideology. *Symbols*, Spring: 5–8, 37.

Willey, Gordon R., and Richard. M. Leventhal
1978 Maya Settlement in the Copan Valley. Archaeology 31(4):32–43.
1979 Prehistoric Settlement at Copan In *Maya Archaeology and Ethnohistory*, pp. 75–102. University of Texas Press, Austin and London.

Willey, Gordon R., Richard. M. Leventhal, and William L. Fash
1978 Maya Settlement in the Copan Valley. *Archaeology* 31:32–43.

Wisdom, Charles
1940 *The Chorti Indians of Guatemala*. University of Chicago Press, Chicago, IL.

Yaeger, Jason and Marcello Canuto
2000 Introducing an Archaeology of Communities. In *The Archaeology of Communities: A New World Perspective*, edited by M. Canuto and J. Yaeger, pp. 1–15. Routledge, London.

Zipf, George K.
1949 *Human Behavior and the Principle of Least Effort*. Addison-Wesley, Reading.